D4.4 - Final dissemination, communication, capacity building and training activities report

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Dissemination Level

- [X] PU: Public
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Glossary of terms and abbreviations used

Terminology/Acronym	Description
DoA	Description of Action
EC	European Commission
GA	Grant Agreement to the project
FCT and BM	Fight against Crime and Terrorism and Border Management
ASRO	Romanian Standards Association

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Executive Summary

The current deliverable *D4.4 Final dissemination, communication, capacity building and training activities report* is the third and final version of the series of deliverables aiming to report all the activities related to the FLEXI-cross project outcomes, disseminated and communicated either internally between the different stakeholders or externally to the consortium members.

This deliverable is part of the reports under the *WP4 Impact Maximization and Outreach* and directly relates to both tasks, *T4.1 Dissemination, communication, and collaboration activities* and *T4.2 Capacity building with national & EU border authorities and training activities*.

Dissemination and communication activities aim to satisfy the project 5th objective, to accelerate the adoption and the take up of the project results in Europe and beyond, which is not feasible unless a well-planned and maintained Dissemination and Communication plan is put in place and adapted on the go during all the project lifecycle duration.

The deliverable monitors and controls a list of KPIs directly related to the activities within the scope of the WP4. As explained in the previous versions of the deliverable, the WP4 is led by EBOS, and involves all the project partners to expose all the project results and finds a larger possible audience, especially within the cross-border authorities, border agencies, IoT and Big Data Communities, ICT SMEs, Academic and Research Communities, etc.

This document is organized using the following structure:

- Section 1 shows the introduction along with the mapping between the grant agreement, WP4 description and the D4.4 sections.
- Section 2 explains the dissemination, communication and collaboration status.
- Section 3 elaborates on the liaison with other projects.
- Section 4 shows the work under the capacity building.
- Section 5 shows the conclusion.

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1 Introduction

This deliverable focuses on the work depicted in both tasks *T4.1 Dissemination, communication, and collaboration activities* and *T4.2 Capacity building with national & EU border authorities and training activities*, aiming to show the progress and follow up on all the dissemination, communication, and capacity building activities. This deliverable is complemented by the deliverable *D4.6 Final commercialisation and impact generation report* (M34) which aims to take the findings and results further, to exploit each separately or collectively and find commercial opportunities for either the whole toolkit or part of it.

1.1 Mapping FLEXI-cross outputs

Table 1: Mapping of FLEXI-cross outputs

FLEXI-cross Task and GA Outline	Respective Document Section(s)	Justification
T4.1 – Dissemination, communication and collaboration activities • Build the foundation and prepare FLEXI-cross "Dissemination, Communication and outreach activities to the defined target audience • Constantly update the project website and the social media channels with latest project activities and outcomes. • This task will also coordinate the efforts of FLEXI-cross partners in the dissemination of the project's achievements by: ○ submitting high quality papers at high impact, peer-reviewed journals and magazines. ○ presenting and publishing results in prestigious conferences. ○ organising workshops, trainings, conference sessions, and tutorials. ○ link the dissemination and communication activities with related initiatives and ongoing projects.	Section 2	In this section of the report, the Dissemination and communication activities of the FLEXI-cross project are detailed. All efforts made by the project partners up to the delivery date of the current deliverable are mentioned in this report, as well as their roles and responsibilities during, and after the project comes to its end.
Task 4.2 Capacity building with national & EU border authorities and training activities • The aim of this task is to enable a continuous exchange of information with national and EU authorities as well as the communication with other relevant EU projects and initiatives. • This task will target to address the logistics, administrative and EU regulations on the different authorities from different	Section 3 and 4	In this section the strategy for the capacity building and the training activities will be developed and planned

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FLEXI-cross Task and GA Outline	Respective Document Section(s)	Justification
countries to reach a high level of compliancy and standardisation for the upcoming pilot cases. Moreover, this task will be responsible for the end-users' training activities, allowing them to use the FLEXI-cross platform and solutions and providing guidance to interested third parties.		

2 Dissemination, Communication and Collaboration Status

This section aims to build upon the foundation laid by the deliverable *D4.3 Intermediate dissemination, communication, capacity building and training activities report*, it shows the progress that was witnessed under the *T4.1 Dissemination, communication and collaboration* activities since the delivery of D4.3. the content is organized into two sections, highlighting communication and dissemination activities.

2.1 Communication and Collaboration Activities

As outlined in the GA, this section provides the FLEXI-cross communication activities, and shows the project partners' various approaches in achieving such activities, while promoting the outcomes of the project to the wider community, such as, the public, the media, etc.

A detailed description of the communication channels and tools of the project is provided, so that the FLEXI-cross consortium reaches its communication target values.

Below Table 2, lists all the communication activities that are expected during the whole course of the project, along with the corresponding KPIs that need to be met.

The current values per KPI are illustrated in each paragraph dedicated to a specific KPI.

Table 2: Communication activities

Communication Channels	Description	Target Audiences	Timeline & Target Values
Project Website	A project website allows easy retrieval of main action data with a few clicks while acting as the core source of information about the project's objectives and activities. The first version was online by M02, and was constantly maintained and updated regularly, running also for 3 years after project end - EBOS undertakes the task.	All end-users	From M02 to 3 years after the end of the project Online by: M02 Unique Visitors from M12: >1,000 Unique Visitors from M36: >2,500
Social media	FLEXI-cross builds and maintains actively its online presence in several social media channels, using X-platform and LinkedIn when interacting with research and innovation communities spreading out new publications, while Facebook and Podcasts are used for wide community engagement, - EBOS undertakes the task.	All end-users	From M02 to M36 Size of online community (by M36): >4,000 No. of impressions (monthly average): >500
e-Newsletters and Email Campaigns	e-newsletters provide a snapshot of the main activities	Border Authorities	Quarterly Issues starting from M04

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Communication Channels	Description	Target Audiences	Timeline & Target Values
	and achievements of FLEXI-cross, whereas broadcasting messages to a target pool of contact points via email is a highly effective measure of engagement, especially when promoting events and outcomes among different domains. Professional marketing platforms (i.e., Sendinblue and Mailchimp) are used to automate the distribution among contact points - ENG undertakes the task.	Staff, Technology Providers and Entrepreneurs, Frequent Travellers, Networks of Practitioners project.	e-Newsletters contributed/released: 9 Total Mailing List Contact Points: >1,500
General Spreading	Leveraging online publishing platforms (e.g., Medium, WIRED) and magazines (e.g. CORDIS Research EU Magazine) enables FLEXI-cross to reach out to a broader audience. Also, all partners will disclose non-confidential information of the project in their national language to local/regional newspapers, media and press, and the impact of the demonstrated trials will be promoted – ATP, KEMEA and BEIA will be leading the public spreading and the authorities and citizen engagement around Europe, with main focus on the demo countries, and beyond.	ALL End-users with a focus on staff involved in border management.	From M09 to M36 Press releases: >10 Events co-organised with local authorities: >3 Attendance per event: >100
Joint Activities with relevant Actions	To further amplify and maximise the outreach of the project's results and to feed them into related international work streams, FLEXI-cross will pursue promotion strategies of various initiatives and clusters, and to contribute and support their actions; i.e., DAIRO through WINGS, AIOTI through EBOS, NESSI, FIWARE and EOS through ENG, COSI, EES, FRAN and eu-LISA through HPOL, EARTO and ECSO through KEMEA.	All Stakeholders with a special focus on ICT Professionals, Societal Actors, Alliances, relevant Public Bodies, Vertical Associations.	From M18 to M36 Number of relevant initiatives and clusters to contribute: 5 Co-organised activities: >4

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Communication Channels	Description	Target Audiences	Timeline & Target Values
Printed Material	Reference promotional instruments when participating in events, including brochures, catalogues, posters and any other laid out paper-based resource. Most of the material will be available as e-documents and printing will occur as required. FLEXI-cross will explore alternatives for labelling gadgets and merchandise, which have turned out quite an effective means of promoting initiatives among a less specialised audience - EBOS undertakes the design.	ALL End-users attending physical events.	From M02 to M36 No. of hard copies (i.e., brochures, flyers, posters, etc.) distributed: >2,000 Roll-up Banners: >4
Blogs	FLEXI-cross will connect and execute periodic broad promotion activities in open communities, blogs, non-profit organisations and channels such as: Gitter Communities - ENG undertakes the task.	Digital Innovation Hubs, Relevant Associations, Academia.	From M23 to M36 Unique Publications/Contributions to Blogs: >6 Different Blogs to Post: >4
Multimedia	The project will produce multimedia material (a short video for each trial) to have a self-explanatory and appealing presentation of the project, leveraging available distribution channels of promotion (e.g., YouTube, Vimeo). Also, a set of video interviews, both from scientific partners and citizens, to collect inputs, taking advantage of plenary meetings and events of relevance will be implemented – WINGS undertakes the task.	ALL End-users focusing on Local Authorities and Revenant Actors.	From M09 to M36 No. of short videos and interviews produced (in total): 4 Number of views: >3,000

2.1.1 Project website

The FLEXI-cross website (https://flexicross-project.eu/) serves as the primary communication channel between the public and the FLEXI-cross partners. It aims to provide information about the project and regular updates on various project activities.

The website is designed to be user-friendly and accessible across different operating systems and devices. Within this section we will show the progress in terms of project activities posted on the website in addition to some dashboard graphs that shows some analytics.

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For the analytics, we will use the google analytics that will help the FLEXI-cross consortium document and track the project website pages that users are visiting. All the information is described in the cookies policy available at the dedicated page https://flexicross-project.eu/cookies-policy/. It is a methodical way to acknowledge users' interest in the project, improve the website content, and create a better online interaction with the project. The main aim of recording user's engagement on the project website and its various pages is to ensure that the project is well-disseminated and communicated, the content is understandable and of good quality, and hence, it ensures user's return and commitment to the FLEXI-cross website.

2.1.1.1 Project website analytics

Since the 1st of September 2022, which marked the start of FLEXI-cross project, project partners participating in the *WP4 Impact Maximization and Outreach* and especially in the *T4.1 Dissemination, communication and collaboration activities* with the lead of EBOS, managed to engage and attract external stakeholders and expose the project research activities and achievements.

The effort invested was reflected by the number of users visiting the website and the number of engagements from the visitors. Accordingly, the website was visited by 1574 unique visitors and experienced around 1893 engaged sessions until 18th of Jul 2025, most of the sessions were direct engagement or through organic search, as shown in Figure 1 below.

	First user prim...Channel Group)	Total users	New users	Returning users	Average engagement time per active user	Engaged sessions per active user	Event count All events	Key events All events	User key event rate All events
	Total	1,543 100% of total	1,574 100% of total	312 100% of total	10m 50s Avg 0%	1.23 Avg 0%	438,484 100% of total	0.00	0%
1	Referral	582 (37.72%)	582 (36.98%)	29 (9.29%)	34s	1.05	3,913 (0.89%)	0.00 (–)	0%
2	Direct	477 (30.91%)	506 (32.15%)	136 (43.59%)	33m 07s	1.48	428,669 (97.76%)	0.00 (–)	0%
3	Organic Search	423 (27.41%)	423 (26.87%)	140 (44.87%)	1m 19s	1.25	5,431 (1.24%)	0.00 (–)	0%
4	Organic Social	62 (4.02%)	62 (3.94%)	9 (2.88%)	35s	0.69	467 (0.11%)	0.00 (–)	0%
5	Unassigned	1 (0.06%)	1 (0.06%)	0 (0%)	17s	1.00	4 (<0.01%)	0.00 (–)	0%

Figure 1: Type of sessions

Figure 1 as well shows the high average engagement rate of the user, which indicate the attractiveness of the content shared and explored within the project website, on overall type of sessions, the average rate was calculated as 6 min 08 sec.

Figure 2 below shows the total number of events, main page visit and view or user engagement sessions. From the figure we can witness the huge interest in the project activities and the engagement from all the project followers and external audience.

	Event name	Event count	Total users	Event count per active user	Total revenue
	Total	438,484 100% of total	1,543 100% of total	284.18 Avg 0%	€0.00
1	page_view	239,332 (54.58%)	1,537 (99.61%)	155.71	€0.00 (–)
2	user_engagement	194,298 (44.31%)	1,378 (89.31%)	142.34	€0.00 (–)
3	session_start	2,827 (0.64%)	1,535 (99.48%)	1.84	€0.00 (–)
4	first_visit	1,574 (0.36%)	1,534 (99.42%)	1.03	€0.00 (–)
5	click	254 (0.06%)	92 (5.96%)	2.76	€0.00 (–)
6	file_download	199 (0.05%)	78 (5.06%)	2.55	€0.00 (–)

Figure 2: Number of events

Below Table 3 show the evolution of the user acquisition on monthly basis since the project kick-off, until today, which shows that this process was a continuously evolving because of the monthly activities that never stopped throughout the project progress.

Table 3: Project website unique visitors

Website	
Month	**number of unique visitors**
Sep-22	60
Oct-22	22
Nov-22	18
Dec-22	20
Jan-23	16
Feb-23	29
Mar-23	42
Apr-23	22
May-23	25
Jun-23	20
Jul-23	14
Aug-23	18
Sep-23	16
Oct-23	19
Nov-23	32
Dec-23	20
Jan-24	38
Feb-24	28
Mar-24	44
Apr-24	67
May-24	154
Jun-24	27
Jul-24	13
Aug-24	12
Sep-24	15
Oct-24	21
Nov-24	82
Dec-24	26
Jan-25	29
Feb-25	520
Mar-25	12
Apr-25	33
May-25	22
Jun-25	34
Jul-25	14

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Figure 3 below as well shows graphically the progress of user acquisition.

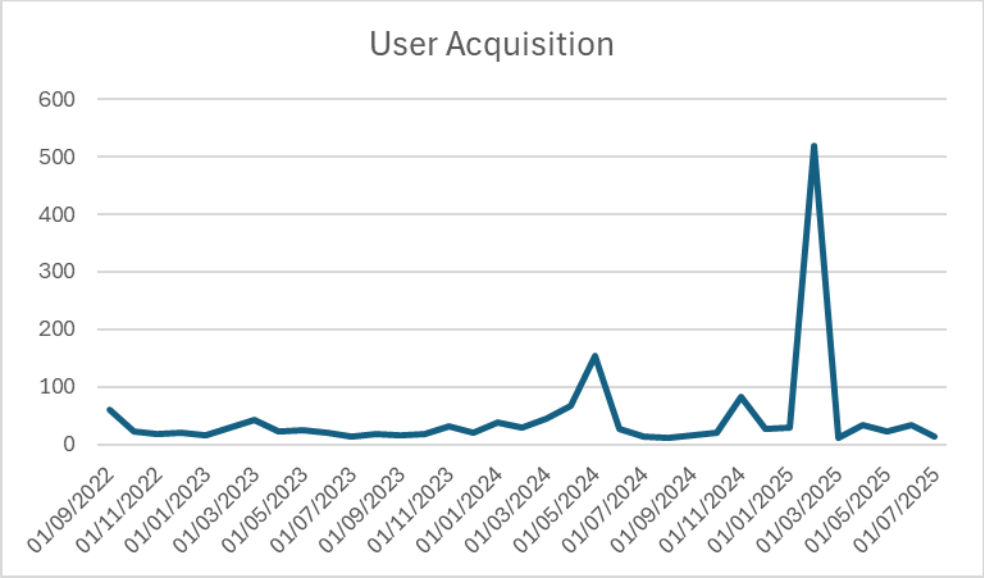

Figure 3: User acquisition

Most of the project website visitors came from the country where the consortium partners come from, which makes sense, Figure 4 below shows the users per country.

Plot rows | Search... | Rows per page: 10 | Go to: 1 | 1-10 of 69

	Country	Active users	New users	Engaged sessions	Engagement rate	Engaged sessions per active user	Average engagement time per active user	Event count All events	Key events All events	User key event rate All events	Total revenue
	Total	1,495 100% of total	1,526 100% of total	1,808 100% of total	66.59% Avg 0%	1.21 Avg 0%	11m 08s Avg 0%	437,712 100% of total	0.00	0%	€0.00
1	United States	553 (36.99%)	562 (36.83%)	603 (33.35%)	96.48%	1.09	10m 40s	147,757 (33.76%)	0.00 (–)	0%	€0.00 (–)
2	Greece	236 (15.79%)	235 (15.4%)	286 (15.82%)	60.47%	1.21	1m 27s	2,790 (0.64%)	0.00 (–)	0%	€0.00 (–)
3	Romania	189 (12.64%)	188 (12.32%)	207 (11.45%)	58.97%	1.10	1m 07s	1,974 (0.45%)	0.00 (–)	0%	€0.00 (–)
4	Cyprus	78 (5.22%)	77 (5.05%)	245 (13.55%)	58.61%	3.14	3m 24s	2,962 (0.68%)	0.00 (–)	0%	€0.00 (–)
5	Italy	67 (4.48%)	66 (4.33%)	72 (3.98%)	45%	1.07	1m 14s	1,000 (0.23%)	0.00 (–)	0%	€0.00 (–)
6	Germany	44 (2.94%)	39 (2.56%)	54 (2.99%)	59.34%	1.23	1m 40s	756 (0.17%)	0.00 (–)	0%	€0.00 (–)
7	United Kingdom	36 (2.41%)	32 (2.1%)	38 (2.1%)	66.67%	1.06	1h 03m	89,931 (20.55%)	0.00 (–)	0%	€0.00 (–)
8	Ireland	31 (2.07%)	28 (1.83%)	4 (0.22%)	12.5%	0.13	8s	134 (0.03%)	0.00 (–)	0%	€0.00 (–)
9	Spain	29 (1.94%)	27 (1.77%)	33 (1.83%)	64.71%	1.14	1m 06s	355 (0.08%)	0.00 (–)	0%	€0.00 (–)
10	China	28 (1.87%)	15 (0.98%)	29 (1.6%)	72.5%	1.04	28m 20s	26,996 (6.17%)	0.00 (–)	0%	€0.00 (–)

Figure 4: Users by country

Figure 4 as well shows a high engagement rate, of 66.59% which reflect the high interest of the project audience.

Plot rows | Search... | Rows per page: 10 | Go to: 1 | 1-10 of 95

	Page title and screen class	Views	Active users	Views per active user	Average engagement time per active user	Event count All events	Key events All events	Total revenue
	Total	2,312 100% of total	422 100% of total	5.48 Avg 0%	1m 31s Avg 0%	5,953 100% of total	0.00	€0.00
1	Home - Flexi-Cross projec	586 (25.35%)	215 (50.95%)	2.73	44s	1,773 (29.78%)	0.00 (–)	€0.00 (–)
2	Home - FLEXI-Cross	333 (14.4%)	150 (35.55%)	2.22	32s	1,018 (17.1%)	0.00 (–)	€0.00 (–)
3	Consortium - Flexi-Cross projec	98 (4.24%)	75 (17.77%)	1.31	19s	232 (3.9%)	0.00 (–)	€0.00 (–)
4	News and Events - Flexi-Cross projec	95 (4.11%)	29 (6.87%)	3.28	45s	235 (3.95%)	0.00 (–)	€0.00 (–)
5	Concept and Methodology - Flexi-Cross projec	90 (3.89%)	61 (14.45%)	1.48	55s	199 (3.34%)	0.00 (–)	€0.00 (–)
6	Newsletters - Flexi-Cross projec	64 (2.77%)	30 (7.11%)	2.13	19s	162 (2.72%)	0.00 (–)	€0.00 (–)
7	News and Events - FLEXI-Cross	62 (2.68%)	20 (4.74%)	3.10	1m 15s	148 (2.49%)	0.00 (–)	€0.00 (–)
8	Consortium - FLEXI-Cross	51 (2.21%)	34 (8.06%)	1.50	57s	135 (2.27%)	0.00 (–)	€0.00 (–)
9	Objectives - Flexi-Cross projec	46 (1.99%)	32 (7.58%)	1.44	32s	95 (1.6%)	0.00 (–)	€0.00 (–)
10	Contact us - Flexi-Cross projec	41 (1.77%)	26 (6.16%)	1.58	17s	94 (1.58%)	0.00 (–)	€0.00 (–)

Figure 5: User views

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The website witnessed around 2312 view sessions since the beginning of the project, most of the view session either converged to the home page or to the consortium and news and events pages.

Figure 5 above, shows the corresponding number of views per each project website page.

2.1.2 Social Media activities

In line with project partner commitment for a transparent communication and widespread dissemination of project information, FLEXI-cross partners led by EBOS has established a strong presence on the main social media platforms, LinkedIn (https://www.linkedin.com/company/87218199/admin/page-posts/published/), X (Former Twitter) (https://x.com/flexi_cross), and YouTube (https://www.youtube.com/channel/UCrqRl4JaP3smuOoFfT8v49Q/featured), which serve as dynamic pages and environment to engage with the project audience and share the latest developments and achievements.

1. LinkedIn: LinkedIn page serves as a professional platform for project connect addressed to industry experts, collaborators, and stakeholders.
   Regular updates on project activities, events and research findings and achievements are shared through this medium to foster a community of knowledge exchange.
   Announcement of events, and project highlights are shared through this medium.
2. X (Former Twitter): X page is used for quick information dissemination, ensuring that followers stay informed about the latest news and activities related to the FLEXI-cross project.
3. YouTube: YouTube channel is a powerful medium, and serves as a repository for project videos, webinars, and multimedia content.

By using the above social media platforms, project partners aim to improve the project awareness and audience engagement, the selection of the platform was strategically selected due to the profile of users using each of the platform which give the project more exposure and visibility.

The Table 4 below, presents the posts created on each of the project social media pages, X-platform and LinkedIn, along with some analytics for each, during the respective month of postage.

Table 4: X and LinkedIn platform posts with analytics

X and LinkedIn platforms						
Month		Total number of posts	Details	Total number of retweets	Total number of likes	Total number of views
Feb-23		1	ingenious virtual participation	1	2	146
Mar-23		2	Promenade	1	2	29
			1st Newsletter	1	1	21
Apr-23		1	RISE-SD participation	1	1	33
May-23		2	1st video for project	0	1	35
			RISE-SD happening now	2	3	96
Jun-23		2	FLEXI-cross at RISE-SD event	2	2	16
			PC presenting the project in project for policy seminar	1	3	41

X and LinkedIn platforms						
Jul-23		0	-	-	-	-
Aug-23		0	-	-	-	-
Sep-23		4	4th plenary meeting	2	2	73
			87th Thessaloniki International Trade Fair	1	1	38
			synergy with TENSOR project	0	0	20
			PC participation in MEDEA panel session for border security	1	2	57
Oct-23		7	7 partners presented their companies and their contribution to the FLEXI-cross project	7	9	112
Nov-23		2	pre-1st technical workshop dissemination	2	4	34
			FLEXI-cross participation in METICOS final event - BES cluster	1	2	33
Dec-23		1	1st technical workshop	1	2	37
Jan-24		2	BEIA participation in Gotech 23	2	3	85
			workshop announcement with I-SEAMORE and ODYSEUS	2	3	67
Feb-24		2	2nd project newsletter	1	2	37
			KEMEA participation in CERIS workshop	1	4	131
Mar-24		3	1st blog article	1	3	35
			5th plenary meeting	1	3	35
			Joint workshop FCT and BM project clustering	1	5	36
Apr-24		3	1st review meeting in Brussel	2	5	53
			2nd blog article	2	4	33
			3rd project newsletter	2	4	31
May-24		1	Early platform validation in Ormenio by WINGS and KEMEA	2	8	94
Jun-24		2	Participation in EARTO WGSD	12	26	123
			Collaboration with I-SEAMORE for citizens awareness and acceptance of EU maritime security systems	5	9	65

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X and LinkedIn platforms						
Oct-24		2	6th plenary meeting in Cyprus	2	6	35
			Joint webinar on the ethical and societal impact of security tech in border management	1	4	32
Nov-24		6	Joint workshop with sister project to showcase how AI is transforming maritime sector	3	6	53
			Live demo in Cyprus meeting	1	4	29
			Live demo at Galati port by BEIA	2	5	24
			New press release by BEIA	3	6	31
			5th newsletter	5	6	41
			Project participation in Innopro 2024 event	2	7	39
Dec-24		2	Joint webinar on new solutions in border management	3	9	60
			6th project newsletter	1	1	14
Feb-25		1	Showcase of UC2 in Ormenia	1	1	14
Apr-25		5	Joint workshop on AI operations in border management	1	1	17
			7th project newsletter	2	1	21
			6th project press release	2	1	14
			4th blog article	2	1	17
			7th project press release	3	2	26
May-25		1	Detection hub participation announcement and invitation to register	2	1	16
Jun-25		2	UC1 Trial	1	3	24
			UC2 demonstration	1	2	50
			SRE 2025 event	1	5	62

Concerning the audience interaction with the project activities over the social media pages, it is imperative to highlight the high engagement, especially through user impressions that reflect the user interest with the project domain and achievements.

Table 5 below, shows the number of impressions recorded monthly, while Figure 6 depicts illustrates the trend of impressions throughout the project progress on the different social media platform, as well as the total impressions from all the platforms.

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Table 5: Impressions count

Impressions	LinkedIn	X	Total
January 2023	882	280	1287
February 2023	755	166	965
March 2023	544	104	729
April 2023	392	85	509
May 2023	1161	107	1294
Jun 2023	1364	161	1592
July 2023	220	106	326
August 2023	28	15	43
September 2023	1523	137	1753
October 2023	2053	208	2326
November 2023	368	118	548
December 2023	444	114	591
January 2024	595	154	749
February 2024	628	170	798
March 2024	1329	109	1438
April 2024	1457	118	1575
May 2024	1238	95	1333
June 2024	568	125	693
July 2024	206	0	206
August 2024	18	0	18
September 2024	51	66	117
October 2024	1223	69	1292
November 2024	1707	223	1930
December 2024	902	97	999
January 2025	430	0	430
February 2025	441	15	456
March 2025	135	0	135
April 2025	1328	68	1396
May 2025	384	18	402
June 2025	2174	139	2313

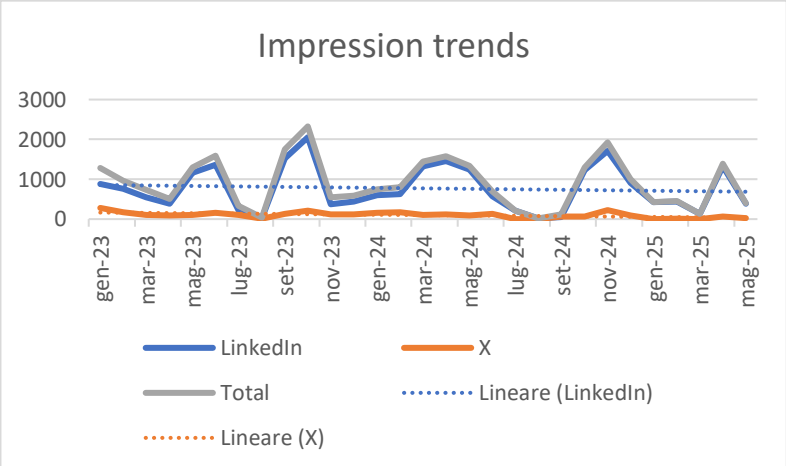

Figure 6: Impressions/social media platforms

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For more insights on the user engagement, Tables 6, 7 and 8 below, show some additional metrics for measuring the user interactions to the FLEXI-cross social media pages.

Table 6: The project clicks/reach/engagement over x and LinkedIn platforms

Clicks/Reach/Engagement	LinkedIn clicks	X engagement	Total
January 2023	57	27	175
February 2023	46	7	81
March 2023	30	8	96
April 2023	24	7	54
May 2023	7	15	37
Jun 2023	57	24	130
July 2023	63	0	63
August 2023	0	0	0
September 2023	276	18	362
October 2023	14	26	86
November 2023	21	13	90
December 2023	25	9	65
January 2024	38	22	60
February 2024	32	18	50
March 2024	28	20	48
April 2024	35	28	63
May 2024	26	16	42
Jun 2024	49	43	92
July 2024	17	0	17
August 2024	2	0	2
September 2024	0	14	14
October 2024	216	21	237
November 2024	80	84	164
December 2024	37	29	66
January 2025	30	0	30
February 2025	20	4	24
March 2025	5	0	5
April 2025	55	31	86
May 2025	7	8	15
June 2025	612	21	633

Table 7: The project posts over the different social media platforms

Posts	LinkedIn	X	Total
January 2023	3	5	12
February 2023	3	1	5
March 2023	2	2	6
April 2023	1	1	3
May 2023	2	1	5
Jun 2023	3	3	9
July 2023	0	0	0

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Posts	LinkedIn	X	Total
August 2023	0	0	0
September 2023	5	4	13
October 2023	6	8	21
November 2023	2	2	6
December 2023	1	1	3
January 2024	2	2	4
February 2024	2	2	4
March 2024	3	3	6
April 2024	3	3	6
May 2024	1	1	2
Jun 2024	1	1	2
July 2024	0	0	0
August 2024	0	0	0
September 2024	1	1	2
October 2024	2	2	4
November 2024	6	6	12
December 2024	2	2	4
January 2025	0	0	0
February 2025	1	1	2
March 2025	0	0	0
April 2025	5	5	10
May 2025	1	1	2
June 2025	6	3	9

Table 8: The project likes and reactions over the different social media platforms

Likes and reactions	LinkedIn	X	Total
January 2023	45	4	57
February 2023	32	2	34
March 2023	52	5	65
April 2023	24	3	29
May 2023	74	5	80
Jun 2023	127	7	140
July 2023	3	5	8
August 2023	2	0	2
September 2023	102	1	108
October 2023	85	13	100
November 2023	27	4	33
December 2023	13	7	22
January 2024	13	6	19
February 2024	15	6	21
March 2024	18	11	29
April 2024	18	13	31
May 2024	14	8	22
Jun 2024	46	26	72
July 2024	7	0	0
August 2024	0	0	0
September 2024	3	9	12
October 2024	78	8	86

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Likes and reactions	LinkedIn	X	Total
November 2024	92	34	126
December 2024	43	15	58
January 2025	26	0	26
February 2025	20	1	21
March 2025	0	0	0
April 2025	95	6	101
May 2025	21	1	22
June 1015	178	10	188

In conclusion, the provided figures illustrate the dynamic nature of the FLEXI-cross project's social media reach. Monitoring these impressions enables us to understand the emerging trends, identify periods of successful engagement, and highlight areas for potential improvement in social media strategy.

2.1.3 E-Newsletters and Email campaigns

As previously outlined in Deliverable D4.3, the E-Newsletters produced within the framework of the FLEXI-cross project serve as a communication tool prepared to communicate project achievements to external audience.

These newsletters aim to highlight key achievements, share notable progress and findings, and maintain engagement with stakeholders, including the public, policymakers, researchers, and industry actors.

After the submittal of Deliverable D4.3, which described the initial structure and approach for the E-Newsletters, project partners have successfully published the remaining eight editions, which were issued in a timely and consistent manner, ensuring that the project's milestones, events, technical advancements, and collaboration opportunities were effectively communicated. The content was tailored to be accessible and informative, aligning with the overarching dissemination and communication strategy of FLEXI-cross.

In this section we will present the details of each of the eight newsletters, outlining the corresponding content, publication dates, topic, thereby illustrating the sustained effort in promoting the project's visibility and reinforcing its impact across the target audiences.

2.1.3.1 E-newsletter 2

This edition of newsletter focused on "AR situational awareness and border security", showing how the Augmented reality technology can improve the operational work in the border sector.

It begins by showing the importance of the border security and how mandatory is to mitigate overall threats, such as terrorism, human trafficking and smuggling, illegal migration and move next to show how AR situational awareness technology can integrate real time data, such as maps, related information, event generation/handling, into a user friendly vision through AR glasses or head mounted displays. This function and innovation enable border control personnel to make better informed decisions, enhances collaboration and even secure remote assistance and support of back office in critical situations.

This technology is implemented and integrated within the overall FLEXI-cross toolkit by our project partner HOLO light and is tailored to provide 3D visualisation that will be demonstrated in Use Case 1 in Galati port.

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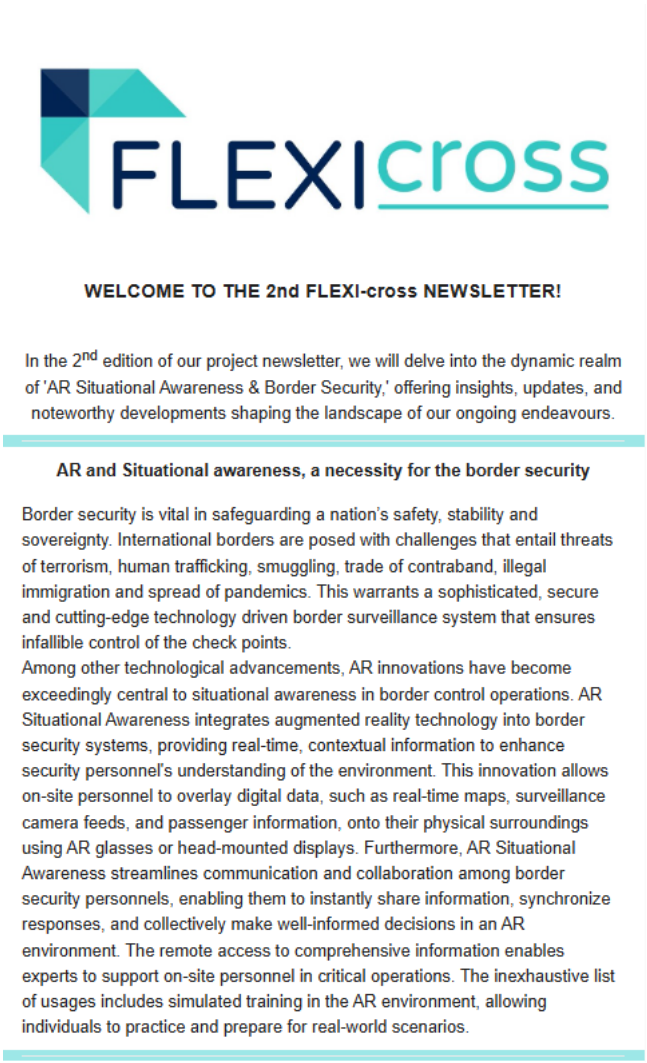
Furthermore, the newsletter describes how the AR module will complement other project components including the face recognition modules, acoustic and radiation sensing detection and intelligent surveillance system.

Finally, some preliminary results are shown which shows how HOLO partner has successfully developed a prototype for testing the interoperability between the different systems and data.

Figure 7 shows the first page of this newsletter.



WELCOME TO THE 2nd FLEXI-cross NEWSLETTER!

In the 2nd edition of our project newsletter, we will delve into the dynamic realm of 'AR Situational Awareness & Border Security,' offering insights, updates, and noteworthy developments shaping the landscape of our ongoing endeavours.

AR and Situational awareness, a necessity for the border security

Border security is vital in safeguarding a nation's safety, stability and sovereignty. International borders are posed with challenges that entail threats of terrorism, human trafficking, smuggling, trade of contraband, illegal immigration and spread of pandemics. This warrants a sophisticated, secure and cutting-edge technology driven border surveillance system that ensures infallible control of the check points.

Among other technological advancements, AR innovations have become exceedingly central to situational awareness in border control operations. AR Situational Awareness integrates augmented reality technology into border security systems, providing real-time, contextual information to enhance security personnel's understanding of the environment. This innovation allows on-site personnel to overlay digital data, such as real-time maps, surveillance camera feeds, and passenger information, onto their physical surroundings using AR glasses or head-mounted displays. Furthermore, AR Situational Awareness streamlines communication and collaboration among border security personnels, enabling them to instantly share information, synchronize responses, and collectively make well-informed decisions in an AR environment. The remote access to comprehensive information enables experts to support on-site personnel in critical operations. The inexhaustive list of usages includes simulated training in the AR environment, allowing individuals to practice and prepare for real-world scenarios.

Figure 7: The screenshot of newsletter 2

2.1.3.2 E-newsletter 3

This edition focused on “Blockchain for border security and cargo identification” while showing how blockchain technology is integrated into the project for improving the efficiency, transparency and trustworthiness of the cargo processing task.

The newsletter explains the context in which the blockchain technology was applied and used within the FLEXI-cross, specifically targeting the Use Case 3, the Romania-Moldova railway. Stakeholders involved, such as border authorities, customs agencies, and shipping companies all benefit from this technology which secure data exchange and facilitate procedures and traceability.

Within the context of FLEXI-cross, the newsletter emphasizes blockchain's potential to foster cross-border collaboration between Romanian and Moldovan authorities. By providing a shared, trusted platform for storing and accessing data, it enables both sides to harmonize procedures and accelerate the cargo handling process at the rail border crossing.

Furthermore, the newsletter details the implementation progress of this technology within the project. Specifically, blockchain is being deployed as a secure storage solution for all events and data recorded by the Cargo Identification Module, a key component in Use Case 3.

Figure 8 shows the first page of this newsletter.

WELCOME TO THE 3rd FLEXI-cross NEWSLETTER!

In the 3rd edition of our project newsletter, we will delve into the 'Blockchain', while showing how FLEXI-cross project integrates this technology to improve border security, specifically targeting cargo identification and management at the Romania-Moldova borders in Giurgiulesti.
Stakeholders include border security agencies, customs, and shipping companies. Blockchain ensures secure, immutable data records, streamlines customs clearance, and supports real-time cargo tracking, significantly enhancing efficiency and reducing fraud. This crucial development, set for mid-summer 2024 implementation, marks a significant advancement in modern border management, fostering trust and collaboration across borders.

Blockchain, a necessity for the border security

Blockchain technology significantly enhances cargo management and identification by providing a secure, immutable record-keeping system that ensures the integrity of cargo data and fosters confidence within the supply chain. It employs encryption and smart contracts to secure cargo information and automate customs clearance, reducing the need for human intervention and minimizing errors or fraud. Blockchain also promotes interoperability across border security and cargo management agencies, enabling seamless data exchange. Furthermore, it offers real-time tracking of cargo, improving logistics management and addressing issues like theft or loss more efficiently. By facilitating transparent and auditable transactions, blockchain aids in compliance with trade regulations and enhances fraud prevention. Additionally, analyzing historical blockchain data can help in risk assessment and resource optimization for better security.

Figure 8: The screenshot of newsletter 3

2.1.3.3 E-newsletter 4

The fourth edition of E-newsletter centered on the topic "Situational awareness and biometric authentication in border security", presenting the vital role of the situational awareness function to improve the effectiveness of biometric verification in border control environment.

The newsletter begins by reinforcing the importance of biometric authentication as a core component of secure border control operations, providing accurate identity verification. However, it emphasizes that biometric systems alone are not sufficient. The integration of Situational Awareness (SA) is highlighted as essential for enabling real-time monitoring and proactive threat detection, ensuring

swift and informed responses to suspicious behaviour involving individuals or vehicles at border checkpoints.

This newsletter outlines how FLEXI-cross leverages SA technologies, particularly through the Event Driven Situational Awareness (EDSA) system developed by the project coordinator, Engineering Ingegneria Informatica S.p.A. EDSA is designed to analyse real-time event data, dynamically adapting to evolving border situations, and significantly improving the responsiveness, accuracy, and reliability of border management.

Functionally, EDSA features a user-friendly interface with capabilities such as event management dashboards, real-time visualizations of entities and events, and interactive geographic maps. These tools offer spatial context to ongoing incidents and facilitate better decision-making. Additionally, advanced features such as facial recognition further enhance the system's ability to identify threats and manage responses effectively.

The newsletter also highlights the privacy and data protection aspects of EDSA. Developed in full compliance with GDPR and the EU Entry-Exit System (EES) regulations, the system incorporates data anonymization, multi-level access control, and a secure orchestration layer to ensure seamless integration with global systems while preserving data privacy.

Figure 9 shows the first page of this newsletter.

WELCOME TO THE 4th FLEXI-cross NEWSLETTER!

In the 4th edition of our project newsletter, we will explain the importance of 'Biometric authentication', which is a cornerstone of border security, providing a reliable method for verifying identity. However, integrating situational awareness (SA) is crucial to enhance effectiveness. Situational awarness enables real-time monitoring of the environment, facilitating swift responses to suspicious activities.

Situational Awareness, a necessity for the border security

Situational awareness allows operators to continuously monitor the environment, reacting promptly to unusual events involving people or vehicles. Leveraging advanced sensors and algorithms, Situational Awareness systems identify potential threats, alerting operators and enabling timely action. By adhering to strict security and privacy standards, SA ensures secure data processing and global integration with external systems.

Why Situational Awareness is important within the FLEXI-cross project context

The FLEXI-cross project advances biometric authentication at borders using state-of-the-art technologies. Engineering Ingegneria Informatica S.p.A., the project coordinator, deployed Event Driven Situational Awareness (EDSA) to leverage real-time event data and enable dynamic responses to evolving border scenarios. Integrating SA into biometric authentication sets new standards in security, accuracy, and user experience.

Figure 9: The screenshot of newsletter 4

2.1.3.4 E-newsletter 5

The fifth edition of the FLEXI-cross e-newsletter focuses on the topic "Enhanced Situational Awareness through Unmanned Aircraft Systems (UAS),". It showcases the integration of advanced aerial surveillance technologies in border security operations.

It begins by highlighting the critical role of UAS—particularly tethered drones—in providing real-time, high-resolution monitoring over extended periods, overcoming limitations of conventional surveillance methods.

The newsletter presents the INUS-UPE platform developed within FLEXI-cross, a tethered UAV system equipped with edge computing capabilities to detect and analyse unusual patterns. Through real-time processing and a user-friendly interface, the system enables fast and accurate unusual pattern extraction, geolocation, and related events. The newsletter also outlines the platform's successful testing and integration within Use Case 1 (Port-based border crossing) and its live demonstration during the first FLEXI-cross showcase in October 2024, marking a significant milestone in the project's technical progress and real-world applicability.

Figure 10 shows the first page of this newsletter.

FLEXIcross

WELCOME TO THE 5th FLEXI-cross NEWSLETTER!

In the 5th edition of our project newsletter, we will describe the utilization of Unmanned Aircraft Systems (UAS) for enhanced situational awareness.

Background

In the face of evolving challenges in border management and security, advanced technologies are playing a pivotal role in enhancing surveillance and response capabilities. Unmanned Aircraft Systems (UAS), both free-flying and tethered, equipped with edge computing and real-time data processing are reshaping border management capabilities. UAS offer unparalleled mobility and can be deployed swiftly, making them ideal for real-time monitoring. Their flexibility enables them to access locations that are inconvenient or entirely inaccessible by traditional means, allowing for the rapid and cost-effective acquisition of high-resolution images and videos. Tethered drones, in particular, provide a significant advantage by offering long-duration mission capabilities that surpass those of standard free-flight drones, which are typically limited due to battery constraints. By being physically connected to a ground-based power source, tethered UAS can remain airborne for extended periods, delivering continuous surveillance essential for applications like border security, critical infrastructure protection, and disaster response. By combining high mobility, real-time multi-sensor monitoring, and edge processing capabilities, they support the development of intelligent surveillance solutions.

Figure 10: The screenshot of newsletter 5

2.1.3.5 E-newsletter 6

This edition of the E-newsletter, titled "Bridging Gaps and Enhancing Processes: Real-Life insights from End-Users" focuses on the practical implementation of redesigned border control workflows reported directly by end-users.

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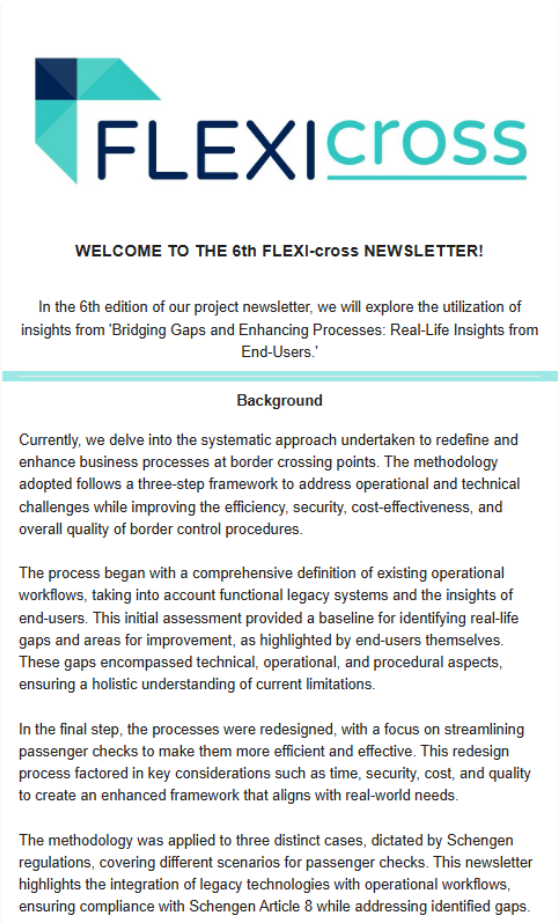
First the E-newsletter presents a well-structured 3-steps methodology used to define and address the operational, procedural and technical gaps found in the current border processes. This has started by doing an in-depth mapping of existing workflows and incorporating real-life input from border control personnel.

FLEXI-cross project aimed to redesign and optimize procedures to enhance efficiency, security, and compliance with Schengen Article 8.

This E-newsletter also highlights preliminary results from three pilot implementations across key European regions—Galati Port in Romania, the Greece-Bulgaria road border, and the Romania-Moldova rail border—each showcasing tailored technological enhancements such as biometric verification, drone surveillance, AR tools, and 5G-enabled systems.

This newsletter emphasizes how the integration of legacy systems with advanced technologies is transforming border management into a smarter, more secure, and user-centric process.

Figure 11 shows the first page of this newsletter.



WELCOME TO THE 6th FLEXI-cross NEWSLETTER!

In the 6th edition of our project newsletter, we will explore the utilization of insights from 'Bridging Gaps and Enhancing Processes: Real-Life Insights from End-Users.'

Background

Currently, we delve into the systematic approach undertaken to redefine and enhance business processes at border crossing points. The methodology adopted follows a three-step framework to address operational and technical challenges while improving the efficiency, security, cost-effectiveness, and overall quality of border control procedures.

The process began with a comprehensive definition of existing operational workflows, taking into account functional legacy systems and the insights of end-users. This initial assessment provided a baseline for identifying real-life gaps and areas for improvement, as highlighted by end-users themselves. These gaps encompassed technical, operational, and procedural aspects, ensuring a holistic understanding of current limitations.

In the final step, the processes were redesigned, with a focus on streamlining passenger checks to make them more efficient and effective. This redesign process factored in key considerations such as time, security, cost, and quality to create an enhanced framework that aligns with real-world needs.

The methodology was applied to three distinct cases, dictated by Schengen regulations, covering different scenarios for passenger checks. This newsletter highlights the integration of legacy technologies with operational workflows, ensuring compliance with Schengen Article 8 while addressing identified gaps.

Figure 11: The screenshot of newsletter 6

2.1.3.6 E-newsletter 7

The seventh e-newsletter edition, titled "Lessons Learned from Early Deployment of FLEXI-cross Toolkit," offers a comprehensive look at the experiences gained during the preliminary trials of the FLEXI-cross technologies. It emphasizes as well on the lessons learned from both end users and technical partners as the project transitions from research to operational.

First, the newsletter explores the real-world implementation of FLEXI-cross technologies across the three use cases—port, road, and rail—where systems like mobile facial recognition, object and vehicle detection, AR interfaces, blockchain-based tracking, and 5G communication infrastructure were tested.

One fundamental criterion from the lessons learned is the importance of human-centered aspect, in which end users noted the need for more intuitive interfaces, smoother integration with legacy systems, and better onboarding due to limited prior experience with similar toolkits. Bureaucratic delays, interoperability gaps, and lack of automation were among the top challenges. However, users also reported significant benefits—such as enhanced situational awareness and decision-making—thanks to the modular and adaptable nature of the toolkit.

Feedback from technical partners underscored the need for data standardization, streamlined access to real-world data, and deeper collaboration with non-technical stakeholders. Challenges such as fragmented databases and varied IT infrastructures required tailored solutions and iterative adaptation. To mitigate these, partners introduced gradual deployment, transparent collaboration, and early end-user involvement.

The newsletter concludes with a set of strategic recommendations shaping future innovation in border management: early user engagement, standardization of data models and APIs, embedded training programs, co-creation over linear delivery, and simplification of user interfaces. These recommendations not only support final project refinements but also provide a replicable model for future AI-driven security projects.

By embedding these lessons into FLEXI-cross's methodology, the project reinforces a user-centric, ethical, and scalable approach to border security innovation.

Figure 12 shows the first page of this newsletter.

WELCOME TO THE 7th FLEXI-cross NEWSLETTER!

In the 7th edition of our project newsletter, we will explore some lessons learned during the preliminary trials, in addition to the experience end user and technical partners witnessed with the FLEXI-cross toolkit.

Background

As AI-enabled border control tools transition from research stage to operational deployment, a crucial step lies in understanding how these tools are received, implemented, and adapted by their ultimate users—border control personnel. This newsletter explores the experiences and challenges encountered during the FLEXI-cross project, drawing from detailed feedback provided by both end users and technical partners. The purpose is to highlight key lessons learned and translate them into practical recommendations for improving future projects that aim to blend technological innovation with border control operations.

Figure 12: The screenshot of newsletter 7

All E-newsletters were sent as campaigns through the Mailchimp, which already have 105 subscribers, receiving regularly all the E-newsletters and project update.

2.1.3.7 E-newsletter 8

The eighth edition of the FLEXI-cross e-newsletter, titled "Validation in Action: Real-World Results from the UC2 Trial at Ormenio BCP," offers detailed insights into the project's continued journey from research to practical implementation. This newsletter showcased the second use case trial, performed on the 8th of May 2025 at the Ormenio Border Crossing Point (BCP).

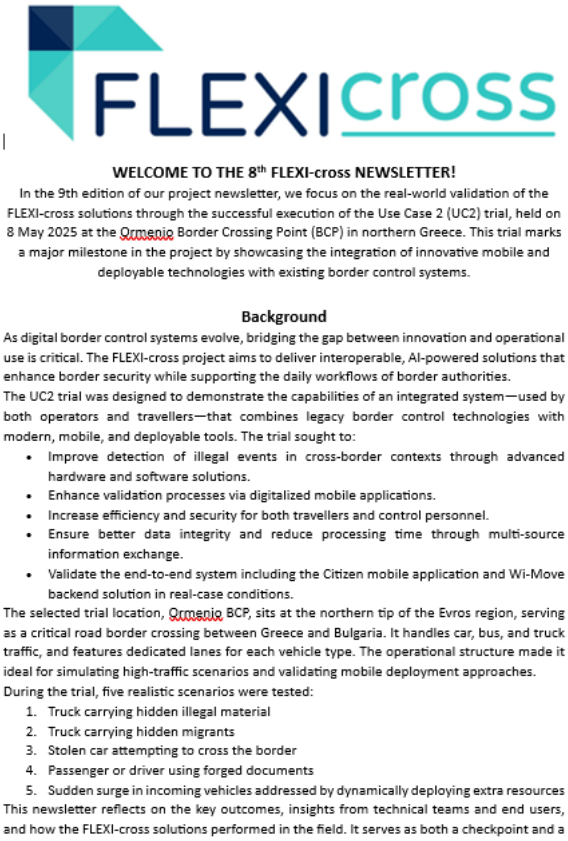
The UC2 trial marked a major milestone in the validation of the FLEXI-cross platform by showcasing how mobile, deployable, and AI-driven technologies can be seamlessly integrated with existing border control legacy systems and infrastructure, aiming to enhance both security and operational efficiency. The trial focused on five high-risk and high-relevance scenarios involving cargo inspection, identity verification, and response to dynamic border flow conditions.

Key outcomes included:

- Real-time anomaly detection using weight sensors and CO_2 detectors.
- Early threat identification through license plate recognition and database cross-checks.
- Improved detection of forged documents using integrated dashboard alerts and biometric tools.
- System adaptability in high-traffic situations through automated resource allocation and live traffic monitoring.

Border officers and technical teams noted substantial benefits from the use of pre-arrival data via the Citizen App, smart sensors, AI-enabled dashboards, and integrated databases. These tools supported proactive decision-making, reduced manual burden, and demonstrated a significant leap forward in digital border control. In conclusion, UC2 trial has successfully validated the toolkit effectiveness during real operational environment, while showing the system's scalability and modularity.

Figure 13 shows the first page of this newsletter.



WELCOME TO THE 8th FLEXI-cross NEWSLETTER!

In the 9th edition of our project newsletter, we focus on the real-world validation of the FLEXI-cross solutions through the successful execution of the Use Case 2 (UC2) trial, held on 8 May 2025 at the Ormenio Border Crossing Point (BCP) in northern Greece. This trial marks a major milestone in the project by showcasing the integration of innovative mobile and deployable technologies with existing border control systems.

Background

As digital border control systems evolve, bridging the gap between innovation and operational use is critical. The FLEXI-cross project aims to deliver interoperable, AI-powered solutions that enhance border security while supporting the daily workflows of border authorities.

The UC2 trial was designed to demonstrate the capabilities of an integrated system—used by both operators and travellers—that combines legacy border control technologies with modern, mobile, and deployable tools. The trial sought to:

- Improve detection of illegal events in cross-border contexts through advanced hardware and software solutions.
- Enhance validation processes via digitalized mobile applications.
- Increase efficiency and security for both travellers and control personnel.
- Ensure better data integrity and reduce processing time through multi-source information exchange.
- Validate the end-to-end system including the Citizen mobile application and Wi-Move backend solution in real-case conditions.

The selected trial location, Ormenio BCP, sits at the northern tip of the Evros region, serving as a critical road border crossing between Greece and Bulgaria. It handles car, bus, and truck traffic, and features dedicated lanes for each vehicle type. The operational structure made it ideal for simulating high-traffic scenarios and validating mobile deployment approaches.

During the trial, five realistic scenarios were tested:

1. Truck carrying hidden illegal material
2. Truck carrying hidden migrants
3. Stolen car attempting to cross the border
4. Passenger or driver using forged documents
5. Sudden surge in incoming vehicles addressed by dynamically deploying extra resources

This newsletter reflects on the key outcomes, insights from technical teams and end users, and how the FLEXI-cross solutions performed in the field. It serves as both a checkpoint and a

Figure 13: The screenshot of newsletter 8

In the following figures, some analytics for the different campaigns are presented.

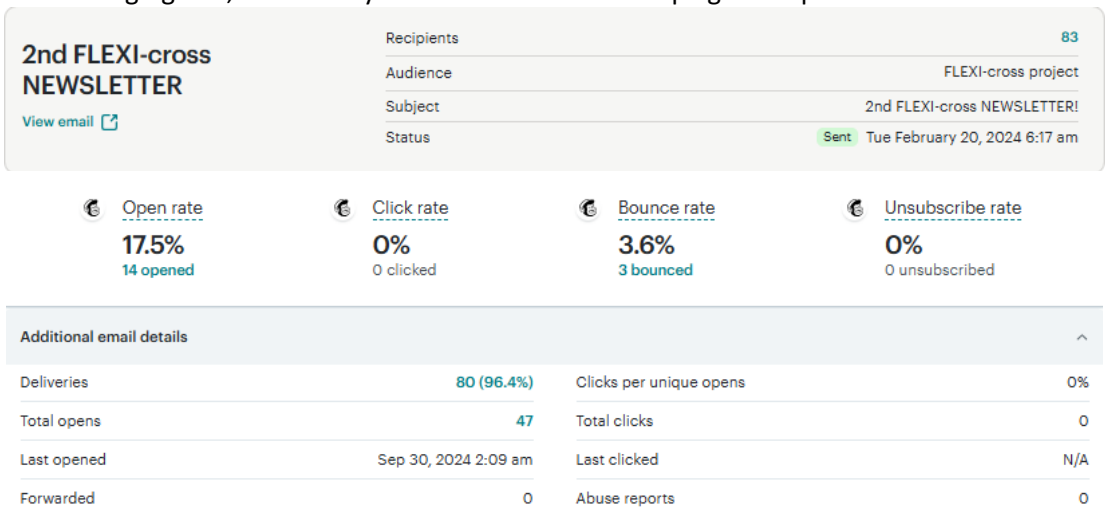


Figure 14: E-newsletter 2 analytics

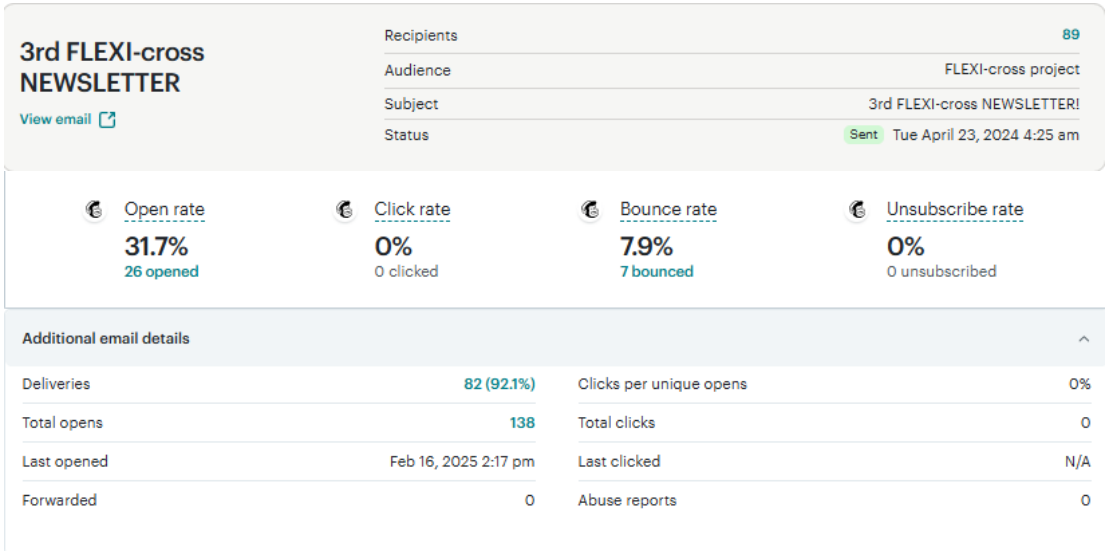


Figure 15: E-newsletter 3 analytics

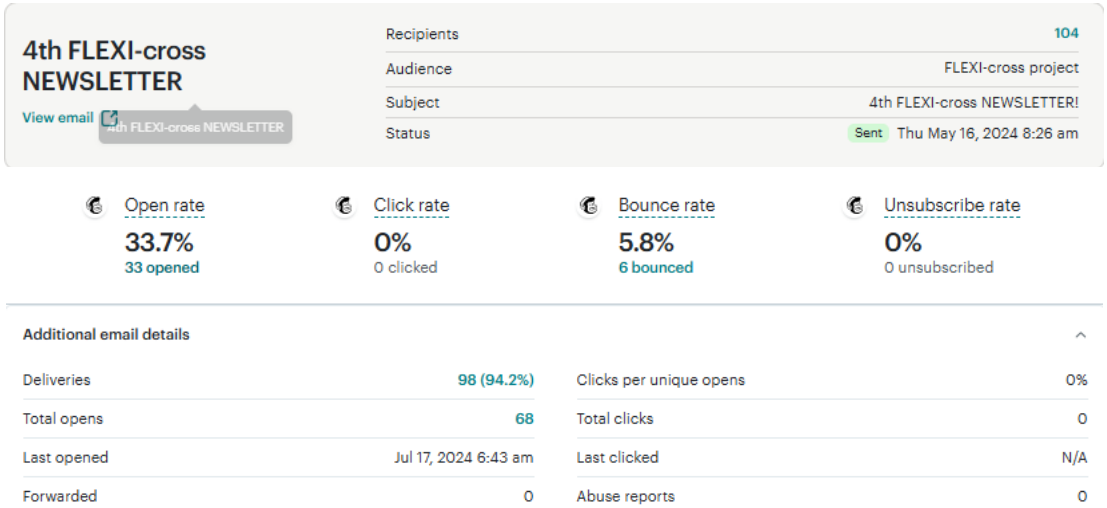


Figure 16: E-newsletter 4 analytics

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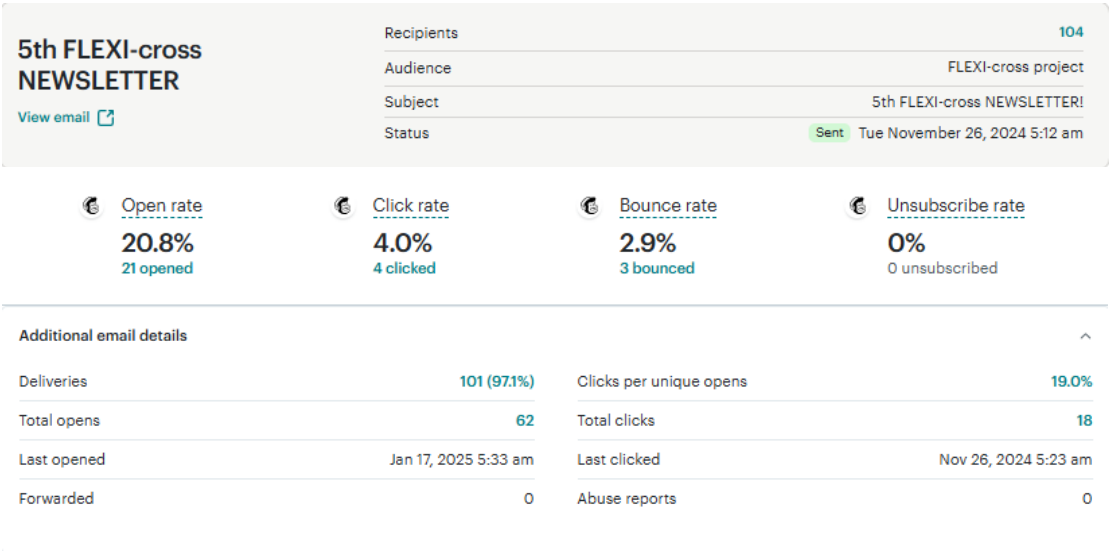

Figure 17: E-newsletter 5 analytics

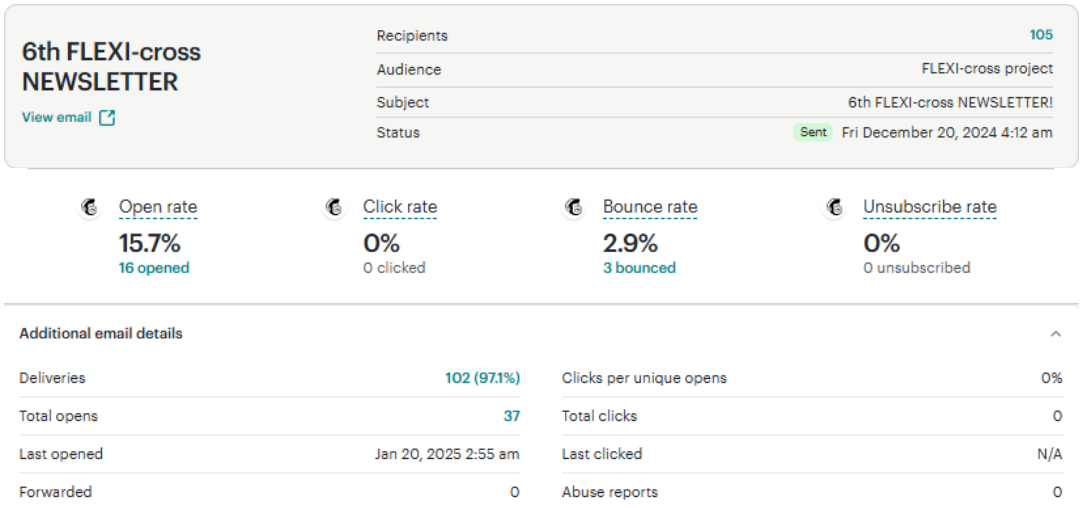

Figure 18: E-newsletter 6 analytics

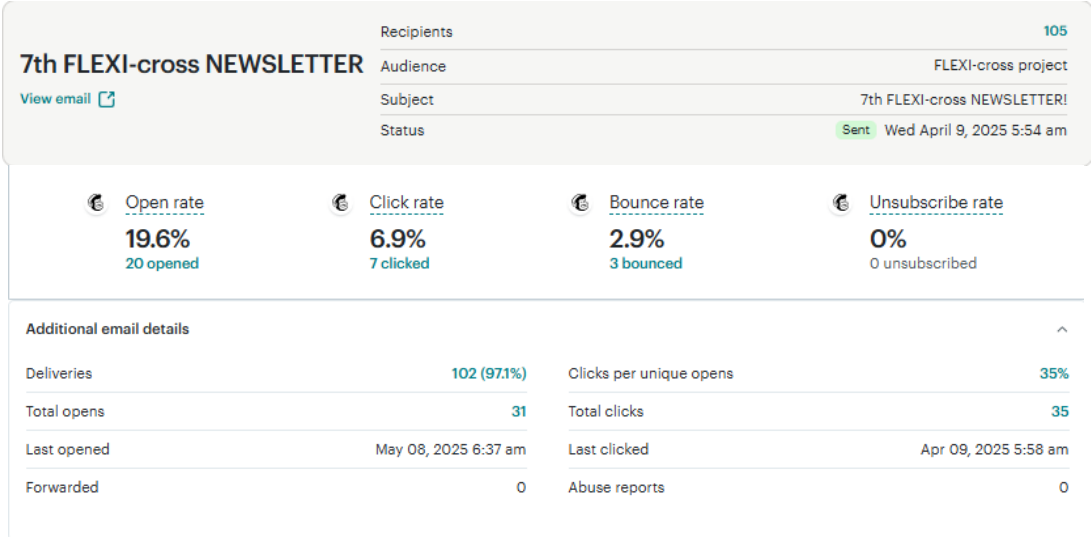

Figure 19: E-newsletter 7 analytics

2.1.4 General Spreading

This part of the communication activities is divided into press releases, and events co-organized with local authorities.

Project partners following the delivery of D4.3, worked on issuing the remaining 9 press releases, which will be described in the following sections.

2.1.4.1 Press release 2

This press release issued in October 2024 aimed to announce the successful hosting by eBOS of the 6th plenary meeting in Nicosia, Cyprus, on October 2–3, 2024. In which a live demonstration was performed with the presence of Frontex representatives, participating remotely to this event.

2.1.4.2 Press release 3

The objective of the press release 3 issued in November 2024 was to showcase the advanced border security technologies through a live demonstration at Galați Port, Romania, for Use case 1.

2.1.4.3 Press release 4

Similarly to the press release 3, this version issued as well in November 2024, showcased a live demonstration of advanced rail border security technologies at the Romania–Moldova crossing, for Use case 3.

2.1.4.4 Press release 5

As for the Use case 2, this press release issued in February 2025, showcased the live demonstration for the integrated, AI-powered border control technologies at Ormenio Border Crossing Point (Greece–Bulgaria).

2.1.4.5 Press release 6

In this version of the press release, FLEXI-cross partners disseminated the Synergy Workshop that was co-organized with TENSOR, ODYSSEUS, and TENACITy addressing jointly the ethical, technical, and standardization challenges of AI in security, especially in the border management realm.

2.1.4.6 Press release 7

The mature visual analytics dashboard developed for a quick and better decision-making process was disseminated within this version of the press release, issued in April 2025.

2.1.4.7 Press release 8

In the press release 8, project partners explored the existing operational process adopted and used in the Galati Port, related to UC1, along with the technology used, and its compliance with the Schengen regulation specifically the Schengen borders code obligations.

Next operational gaps were identified and accordingly the technology was re-designed to fill up the gaps. A new story line was generated to describe the new model recommended, and different personas directly related to this type of border were identified along with the corresponding pain and gain for each.

All the above were used to reach a policy recommendation proposed by the project consortium on many levels, as per the below

- Digital transformation
- Automation and AI-driven security
- Pre-registration and smart processing
- Situational awareness and surveillance

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2.1.4.8 Press release 9

Similarly to the press release 8, while using the same steps, project consortium has drafted policy recommendations for the Ormenio border, related to UC2

2.1.4.9 Press release 10

This press release will be prepared by the end of the project, to announce the final results and the closure of the project

For all the detail content of each of the above press releases, you can visit the project website on the following link:

https://flexicross-project.eu/press-releases/

As for the events co-organized with local authorities, project partners organized during the three final trials, done on site and physically, in different border sites, 3 different events:

1. Co-organized event for Use case1:

On May 14, 2025, BEIA and ATG co-hosted a demonstration event for Use Case 1 (UC1) at Spargatorul Perseus on the Danube River in Galați, Romania. The trial was led by ATG and coordinated by Engineering, in collaboration with key technology partners BEIA, ICCS, EBOS, and HOLO. Observers included WINGS, the Romanian Border Police (IGPF, GIBP), and European Commission Project Officer.

The event served as a live validation of FLEXI-cross's interoperable surveillance capabilities in a maritime port environment, demonstrating how partner technologies are integrated under a common data model and visualized through various interfaces: Engineering's UC1 Control UI, HOLO's Augmented Reality Situational Awareness (ARSA), and EBOS's Visual Analytics Dashboard and Organisational Risk Assessment tools.

Notable contributions included:

- ICCS's INUS-UPE platform for UAV based unusual pattern extraction and related UI as well as FACE-VI mobile app for face verification and identification.
- BEIA's modules for entity recognition, acoustic and radiation sensing, and position tracking.
- Engineering's role-based access control (RBAC) and data export features, enabling secure sharing with systems like the EU Entry/Exit System (EES).

The demonstration simulated five real-world port security scenarios, such as document mismatches, unauthorized boarding, and detection of hazardous materials.

2. Co-organized event for Use case2:

The Greek partners KEMEA and WINGS co-organized with the local Police Office (HPOL) the final trial of all scenarios in the Ormenio Border Crossing Point, located near the border between Greece and Bulgaria, from May 6–9, 2025. During the first two days the partners performed tests on all scenarios to make sure that everything would function well during the actual trial that took place on May 8th, 2025. More than 40 personnel from HPOL, the border guards, and the customs office attended the event in which all scenarios of UC2 were demonstrated. The participants signed a consent form and provided their feedback through a questionnaire.

3. Co-organized event for Use case3:

On May 15, 2025, BEIA and ATG co-hosted a demonstration event at the Brateș train station in Galați, Romania, showcasing the capabilities of the project's Use Case 3 (UC3) focused on rail cargo border surveillance. The event was led by BEIA and co-organized with support from TCCFR, Engineering, and EBOS, bringing together a broad mix of consortium partners and external stakeholders.

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The demonstration simulated real-world scenarios in a functioning rail cargo environment, validating how FLEXI-cross technologies can detect hidden individuals, identify suspicious cargo, and support rapid, data-driven responses by field operators. Participants included representatives from the Romanian Border Police (IGPF), General Inspectorate of Border Police (GIBP), WINGS, HOLO, ICCS, and the European Commission's Project Officer. Local stakeholders from APDM and Galați City Hall (PMG) were also in attendance.

The event highlighted a suite of integrated detection modules developed by BEIA, including:

- Human Trafficking Detection, using audio-video analytics to flag unauthorized access;
- Illicit Cargo Detection, combining radiation sensors and video feeds;
- Multimodal Pattern Detection, fusing multiple sensor streams for unusual pattern detection;
- A unified UC3 Control Interface, providing real-time alerts and operational oversight.

The demonstration included fixed cameras, directional microphones, GPS modules, and radiation sensors, all orchestrated through a centralized dashboard that enabled full situational awareness. Simulated scenarios covered cases such as identity mismatches, pandemic-sensitive cargo, and concealed individuals within freight wagons.

The successful outcome of the trial confirmed the maturity of FLEXI-cross's modular architecture and its ability to operate in low-infrastructure rail environments, aligning detection capabilities with real-time decision-making needs. It also demonstrated seamless integration across hardware and software components provided by different partners.

2.1.5 Joint activities with relevant actions

In addition to the participation in the BES cluster, aiming to foster the collaboration between project for the future of border control, which was already listed in the D4.3, FLEXI-cross project joined 4 additional clusters:

1. FCT and BM project clustering, comprised of many projects under the border management and the Fight crime and terrorism.
   Participating projects, such as TENSOR, EITHOS and ODYSSEUS along with FLEXI-cross conducted on the 12 Mar 2024 a workshop, in which each project presented and showcased the progress achieved within the innovation segment of their respective projects. FLEXI-cross project was represented by Project Coordinator Dr. Giuseppe Vella, D&C&E Manager Mr. Thomas Azrak, Technical Manager Mr. Orestis Manos, and Ethical Leader Mrs. Ioanna Cristina Cotoi.
   Throughout the workshop, numerous insightful discussions occurred, and attendees collaboratively shared their findings and results, which has played a crucial role in shaping the different projects and the future of border security and crime prevention.

2. Project partners, KEMEA, as a member of the European Association of Research and Technology Organisations (EARTO), along with ENG as the project coordinator, jointly presented the FLEXI-cross project during EARTO's Working Group of Security & Defence Research (WGSD). This meeting took place remotely on June 11, 2024.
   The presentation aimed to inform WGSD members about the project's objectives, technologies, and planned trials, and to open a dialogue with experts in the security and defence domain. Approximately 20 participants, all members of EARTO, attended the session.

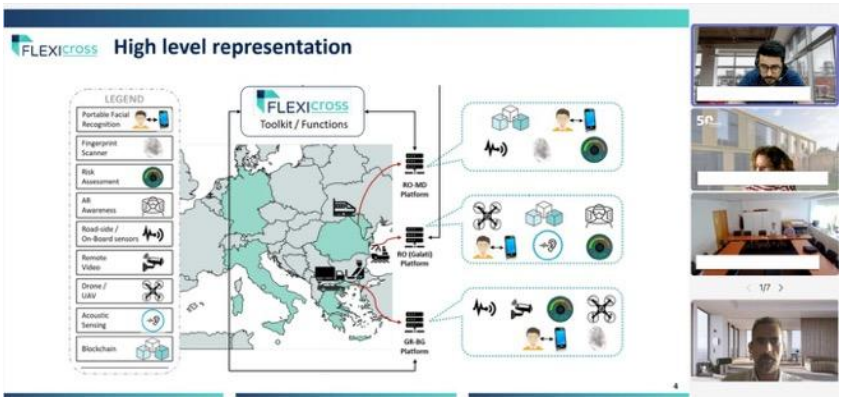

Figure 20: KEMEA presenting FLEXI-cross in WGSD

3. FLEXI-cross consortium represented by the project coordinator, signed a memorandum of understanding with TENSOR project, under Horizon Europe – clustering activities, for collaboration, dissemination, validation and exploitation activities.
   This MoU has no purpose to create a new legal entity, independent from the parties, but to keep each project a separate entity and work together for better findings/results and more exposure.
   Both projects have obligation to protect others confidential information, especially during the joint activities and workshops.

4. Detection HUB, a collaborative dissemination and communication initiative, was formed and led by one of FLEXI-cross project partners, KEMEA, under the main thematic category of detection of drugs, explosives, and illicit goods.
   Many EU funded projects registered and took part of this hub, with main purpose to discuss the challenges LEAs face as well as opportunities for introducing innovative and scientific approaches that will further target stakeholders' engagement and clustering activities, establishing strong synergies with multifaceted goals.
   The added value of the Detection Hub is that each EU funded project will be able to present its findings and objectives, identify common targets and exploitation capabilities, inform the market, and potential end-users from various sectors.

2.1.6 Co-organized activities

Project partners committed to expose the project activities and findings/results to the broader type of audience, co-organized many activities either with the clusters listed in the previous section 2.1.5, or with other sister projects.

The list below comes on top of what was done and listed in the previous deliverable D4.3

1. On the 12th of January 2024, FLEXI-cross project co-organized with other projects, I-SEAMORE and ODYSSEUS a collaborative synergy workshop, aiming to discuss the different points of convergence across three common and key domains, technical solutions in border management, joint dissemination and exploitation strategies and shared ethical and legal framework.

   FLEXI-cross project represented by the project coordinator, actively engaged in shaping the strategy beyond the workshop, with the goal of strengthening cross-project collaboration and enhancing collective impact.

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Figure 21: Synergy workshop with I-SEAMORE and ODYSSEUS projects

2. On the 12th of March 2024, the project took co-organized a workshop under the FCT and BM cluster. Represented by the project coordinator (ENG), D&C manager (EBOS), technical manager (WINGS) and the ethical leader (ENG), FLEXI-cross presented its innovation progress, followed by a series of insightful discussions and exchanges of findings. The project team contributed actively to the collaborative discussions, aimed at shaping the future of border security and crime prevention through shared knowledge and strategic alignment.
3. On the 30th of October 2024, FLEXI-cross project co-organized and participated in a joint workshop titled "Use of AI in border security". This initiative was in collaboration with other EU funded projects, I-SEAMORE, ODYSSEUS and BAG-INTEL.
   Leading experts attended the workshop to discuss and explore how AI is transforming the main areas of the transportation sector, such as maritime situational awareness, customs, border control and many other topics.
   During the workshop, WINGS, the project technical manager presented the project's modular, flexible AI driven systems designed to enhance border control operations.
   This workshop was an additional step forward within the collaboration with other project clusters to move innovation further for better impact within different verticals.
   The full recording or the workshop can be found as well on the below link:
   https://www.youtube.com/watch?v=7w9ebbGRy-Y

Figure 22: Joint workshop, Use of AI in border security

4. Continuing the efforts with similar project and clusters, FLEXI-cross project co-organized and participated on the 20th of November 2024, in the workshop on "Ethical and societal implications of security technologies in border management", similarly to all the workshops,

subject matter experts participated and explored the legal, technological and operational dimensions of border management, while focusing on the influence of the AI Act, privacy issues and the ethical integration of emerging technologies.
Project team presented during the workshop a complete and comprehensive risk assessment tailored on the project toolkit for alignment with the international ethical and legal standards. The presentation covered the evaluation of the benefit as well of the toolkit modules.
The full recording or the workshop can be found as well on the below link:
https://www.youtube.com/watch?v=OsxRZz0LqiE&t=2s

Figure 23: Joint workshop, Ethical and societal implications of security technologies in border management

5. A technical webinar was co-organized by FLEXI-cross and other projects, SIMAVI, BAG-INTEL and I-SEAMORE. The webinar titled "New solutions in Border management" was a platform for projects and participants to explore and showcase the latest advancements in border security technologies and engage with experts, explore state-of-the-art solutions and gain insights into the evolving landscape of border management. FLEXI-cross project highlighted its contributions to enhancing efficiency, safety and compliance in border management.
Below Figure 24 shows the agenda of the webinar showing the different topics covered during the event.

Figure 24: Joint webinar, new solutions in border management

6. On 17 Jun 2025, FLEXI-cross co-organize a joint workshop under the Detection Hub initiative, with the partnership of PARSEC, IFLOWS, COSMOPORT, ODYSSEUS, and Silent Border projects. This collaborative event brought together leading experts, practitioners, and innovators to address current challenges in detecting illicit goods at borders and to explore cutting-edge technological solutions. The workshop featured two key panels: "Smart Detection at Borders," focusing on enhancing parcel and vessel screening capabilities, and "Border Security Innovation," addressing the technical challenges and obstacles faced by EU projects in implementing advanced scanning solutions. FLEXI-cross actively contributed to the cross-project dialogue, reaffirming its commitment to advancing European border security through innovation and collaboration.

Figure 25: Detection HUB workshop initiative

2.1.7 Different blogs posted

A separate section has been created on the project website to post all the blog articles issued by the project partners. This section serves as a dynamic engagement space where all internal and external stakeholders can register to read, comment and engage with each blog.

Each blog covered insights, and updates of experts related to the project activities. To facilitate interaction, an automated communication process was implemented, in which comment/questions submitted by different users were directly forwarded to the blog owner, while responses are reverted to the question/query initiator.

This process ensured a continuous and efficient method for ideas exchange, while enhancing transparency, knowledge sharing.

Below are the 4 different blogs developed

1. Blog #1: This first blog article explores how Augmented reality (AR) is used within the context of situation awareness, is transforming border security operations.

   It shows the importance of the AR in improving real time decision making, the inter communication between authorities and border personnels and the surveillance at border

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checkpoints. The blog showcases the integration of AR within the overall FLEXI-cross toolkit, its practical use case at Galati port, along with the different contributions made by project partners, especially HOLO light and ICCS.

The blog provides the readers with a clear view of how emerging technologies can enhance border safety and operational efficiency.

2. Blog #2: This second edition of blog explores how the "Blockchain" as transformative technology is applied at the Romania-Moldova border to enhance cargo identification and management.

   By using this technology, project partners showed how to create immutable, non-tampered cargo data. This technology is essential in enhancing the trust among value chain players, automates customs clearance and enable real-time cargo tracking.

3. Blog #3: In our third blog article, we show how combining biometric authentication with real-time situational awareness empowers border operators to detect and respond to different threat types. By integrating cutting-edge sensors, intelligent data processing, and user-friendly interfaces, FLEXI-cross enables proactive monitoring of people, vehicles, and events—ranging from anomalies to risks and incidents. Our partner, ENG offering a powerful GUI and in interactive map for event and entity tracking, from facial recognition and object management to GDPR-compliant data handling, event driven situational awareness (EDSA) equips operators with the tools needed for safer and smarter borders.

   This combination marks a major achievement in European border management, in aligning innovative technologies, privacy and real time decision-making.

4. Blog #4: This blog explores some key lessons, learned during the project implementation, in addition to the challenges faced by both end users (border control personnel) and technical partners, while showing what is truly needed to make new technology embedded within current and legacy operations, especially in sensitive environment such as border control.

For the full blog articles, those can be accessed on the link below

https://flexicross-project.eu/blogs/

2.2 Dissemination Activities

Similarly, to Section 2.1, this section provides the FLEXI-cross dissemination activities.

Below Table 9, lists all the dissemination activities that are expected during the whole course of the project, along with the corresponding KPIs that need to be met.

Table 9: The summary of dissemination activities

Dissemination Measures	Description	Target Audience	Target Values
Scientific Publications	Peer-Review Journals: i.e.: Cross Border Journal for International Studies; Global Change, Peace & Security; Big Data Research Journal,	Cross-border Authorities, European Border and Coast Guard and its Agency, Personal Data Registries, National Custom Authorities, Academics	Publishing in Peer-reviewed Journals: > 2 Presenting at Scientific Conferences > 5

Dissemination Measures	Description	Target Audience	Target Values
	Industrial Engineering, etc. Scientific Conferences: Int. Conference on Biometrics for Borders; Int. Border Management Conference; Border Management & Technologies, etc.	and Researchers, and Relevant Consortia.	
Technical Publications	FLEXI-cross will publish and contribute to technical blog posts, articles…, or any other reference from technology providers (bottom-up), as well as references related to the use-case application domains under consideration (top-down). i.e.: Upcoming editions of Frontex Qualifications Framework for Border Guarding, The Data Catalog, etc.	Border Agencies, National Coast Guards, Port Authorities and Private Carriers, IoT and Big Data Communities, Data Spaces, ICT SMEs, Researchers of privacy-preserving solutions.	Publishing Technical Publications: >5 Participation in Industrial Exhibitions with Booths: > 6
Workshops and Trainings	During the project duration, ENG will organise the technical workshops (virtual and physical), BEIA will undertake the training sessions (online training tutorials and physical sessions) & KEMEA will co-organise webinars, as a means of knowledge transfer,	Personnel of Border Institutions, Cross-border Actors and Operators, Data Protection Authorities, Industrial and Public Organisations, IT Experts, Academic and Research Communities.	Technical Workshops: 5 Online and Physical Training Tutorials/Webinars/Training Sessions: >6

Dissemination Measures	Description	Target Audience	Target Values
	capacity building, wider outreach and sustainability.		
Trade Fairs	Participating in symposiums, expo and fairs to interact with multiple stakeholders. Indicative events: Cross-border Expo, WCO Knowledge Academy for Customs, etc.	All Stakeholders with special focus on staff of border authorities, agencies and security union.	Symposiums/Fairs to Participate: >5 Brochures to be Distributed: >400
Standards and Policy Contribution	To achieve high-scale and long-lasting impact, FLEXI-cross aims at influencing standards and policy making, thus obtaining the seal of approval for its newly implemented components, and consequently pushing them into production environments. Interaction with SDOs (i.e. ISO/IEC TR 24028:2020), & Contributions to social and policy innovations (T4.4), with the active participation of all partners.	Standards Developing Organisations, Certification Committees, Decision-makers, Data Protection Authorities, Relevant Public Bodies, Border Institutions, Civil Society Organisations.	Standards Contributions to different Organisations: >3 Policy Recommendations: >3

2.2.1 Scientific publications

This part is divided into 2 different parts, first project partners committed to publish papers in peer review journals, in addition to presenting the project and the findings/results and other project outcomes in scientific conferences.

Those publications and participations aim always to expose all the research done under the project to as much audience as possible, but always without exposing critical and sensitive data to the outside world.

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Therefore, project partners published so far in 2 journals

1. BEIA consult published a paper, under the name of "Entity Recognition on Border Security" in the ACM digital Library, which is one of the most reputable repositories in the computing and information technology field, ACM digital library offers global visibility and credibility, which ensures that results reported will reach both academic and industry stakeholder.
   The full paper can be found in the project website, on the below link:
   https://flexicross-project.eu/publications/
   and accessed directly on the ACM repository:
   Entity Recognition on Border Security | Proceedings of the 19th International Conference on Availability, Reliability and Security
   The publication has the following DOI:
   https://dl.acm.org/doi/abs/10.1145/3664476.3669922#
2. ICCS published a paper, under the name "A Multicomponent Face Verification and Identification system" (https://www.mdpi.com/2076-3417/15/15/8161) in the Applied Sciences journal, which is a peer-reviewed, open access scientific journal, published by MDPI (Multidisciplinary digital publishing institute) and focuses on publishing research and applications in all areas of applied science and engineering aiming to bridge the gap between theoretical research and practical applications.

As for the scientific conferences, the project has been actively presented at many national and international scientific ones, where each provided an opportunity to showcase the project objectives, methodologies and findings/results to the public and research community. Those participations aim to eventually make impact within the project domain.

1. Project partner ENG, participated in the EAB-RPC event in 2023, organized by the European Association for Biometrics (EAB) with the contribution of eu-LISA through its Governance and Capabilities Unit, the support of DG HOME of the European Commission, Fraunhofer IGD and Halmstad University. The project coordinator delivered a presentation about the FLEXI-cross project.

Figure 26: EAB-RPC 2023 conference

2. Project partner ICCS participated to the EEITE 2024 conference and presented the work published in IEEE Xplore (after peer review process) the paper of https://ieeexplore.ieee.org/document/10654396(DOI: 10.1109/EEITE61750.2024.10654396)

Figure 27: EEITE 2024 conference

3. In July 2024, our project partner BEIA consult took part of the ARES 2024 event, the 19th international conference of Availability, Reliability and Security, at the Faculty of Computer Science, University of Vienna, Austria.
The event was organized by SBA research in cooperation with University of Vienna and served as a forum for researchers in IT security, and included more than 200 paper presentations, and 17 keynote talks. BEIA presented the topic of "Entity Recognition in Border Security".

Figure 28: ARES conference

4. In September 2024, FLEXI-cross project coordinator (ENG) along with the technical manager (WINGS) took part of the EAB-RPC 2024 conference, held in Darmstadt, Germany.
EAB-RPC is the largest EU-funded forum dedicated to biometrics and digital identity management and attracts many experts from academia or industry.
Our project participation came after the establishment of a synergy with sister project TENSOR, which focuses on cross-border biometric evidence handling for law enforcement.
During the conference, both projects joined forces to show their complementary objectives and their commitment for the advancement of biometric technologies.

Figure 29: EAB-RPC 2024 conference

5. In October 2024, project partner BEIA sponsored and participated in the INNOPRO 2024 conference, which was held in Ploiești, Romania.
   This conference marked the third edition of the summit by Wallachia eHub and CLUSTERO projects.
   The conference focused on digital solution for SMEs and public authorities, and emphasizing on the below key areas:
   - Twin transition such as energy digitalization and green informatics technologies
   - Digital agriculture
   - Sustainable manufacturing
   - Smart cities and circular economy

   BEIA during this conference presented our project advancement in privacy-preserving biometric technology.

Figure 30: INNOPRP conference

6. On the 3rd and 4th of Jun 2025, project partner BEIA participated in the 6th international conference on machine intelligence & security for smart cities and presented the topic of the Face detection module which improves the operation and security of the borders, BEIA

submitted a paper that highlights the application of AI and computer vision technologies for enhancing border control through real time face verification systems.
The event was organized by National University of Political Studies and Public Administration

7. On the 3rd and 4th of Jun 2025, BEIA participated in the 6th International Conference on Machine Intelligence & Security for Smart Cities and presented the article "Face Detection for Border Security". The conference was organized by the National University of Political Studies and Public Administration - SNSPA.
   In addition, BEIA submitted a paper highlighting the application of AI and computer vision technologies for enhancing border control through real-time face verification systems.

2.2.2 Technical publications

This section lists the different technical publications done under the project scope to expose the research, findings, innovations and technological advancements to both the scientific community and industry stakeholders.

1. The first technical publication produced by our project partner ICCS, and published on the IEEE Xplore (A Tethered Unmanned Aircraft System for Crowd Dynamics and Unusual Pattern Extraction | IEEE Conference Publication | IEEE Xplore) presents the design and implementation of the INUS-UPE platform and the integrated tethered UAV for crowd dynamics and unusual pattern extraction.
   This publication also shows the systems' potential in terms of its integration with other external systems such common operational pictures (COPs), Command & Control (C2) platforms, and Human Machine Interfaces (HMIs).
2. The second technical publication, done by BEIA, focused on Named Entity Recognition (NER), a key Natural Language Processing (NLP) technique that supports the extraction and classification of critical entities—such as names, dates, and locations—from unstructured text. The study outlines the relevance of NER in applications like legal document analysis, travel history assessment, and document verification—which are core areas of FLEXI-cross project. By enabling automated, accurate data structuring and contextual understanding, NER contributes directly to enhancing border security, identity verification, and situational awareness, therefor supporting the project's objective to develop a toolkit for cross-border security and data analysis.
3. The third technical publication, done in the format of a technical catalogue, showing all the technologies used and researched during the whole course of the FLEXI-cross project, along with some data analysis that followed the application of each technology, in addition to the results gained for the overall operation of the border control points.

   For more details of the content of the catalogue, follow the below link
   https://flexicross-project.eu/project-catalogue/
4. Joint white paper with ODYSEUS and TENSOR projects, under the topic of "Improved crime fight and prevention for stronger border and efficient digital forensics"
   This paper presents key insights from four EU-funded projects—FLEXI-cross, TENSOR, ODYSSEUS, and TENACITy— that are all working on border management, travel security, and counterterrorism intelligence. It highlights common challenges, lessons learned, and gaps identified across technical and operational implementations.
   This white paper serves as a roadmap for policymakers, industry stakeholders, and technology experts, fostering a more secure and intelligent approach to border management and counterterrorism.

   The fourth technical publication produced by our project partner ICCS and published on Applied Sciences journal (A Multicomponent Face Verification and Identification System) presents the design and implementation of a face verification and identification system of a flexible,

modular, secure, and scalable architecture. The proposed system incorporates several and various types of system components: (i) portable capabilities (mobile application and mixed reality [MR] glasses), (ii) enhanced monitoring and visualization via a user-friendly Web-based user interface (UI), and (iii) information sharing via middleware to other external systems.

5. BEIA presented the article *"Face Detection for Border Security"* at the 6th International Conference on Machine Intelligence & Security for Smart Cities (3-4 June 2025) organized by the National University of Political Studies and Public Administration - SNSPA as part of the dissemination efforts for the EU-funded project FLEXI-cross. The paper highlights the application of AI and computer vision technologies for enhancing border control through real-time face verification systems.

2.2.3 Participation in industrial exhibition with booth

1. ENG and KEMEA partner participated in the RISE-SD event from 29th till 31st of May 2023, during this participation FLEXI-cross project represented by ENG and KEMEA secured a stand for dissemination, mainly for project awareness and for better exposure and reach.
   During the event, project coordinator, delivered a presentation highlighting the FLEXI-cross toolkit and its innovative technologies that are to be used, such as AI/ML, IOT, AR/XR and UAVs.

Figure 31: FLEXI-cross at RISE-SD 2023

2. KEMEA represented FLEXI-cross project, participated in the 87th Thessaloniki International Trade Fair from 9 till 17 of September 2023. The event was a good opportunity for the project to showcase the project's innovative approach in enhancing EU border security through the development and validation of an advanced border-checking toolkit. Many external stakeholders visited our project booth during the event, from national political figures, ministry representatives, industry stakeholders, and academic institutions, which secured a wide dissemination and visibility of the project's objectives and impact in the field of border management.

Figure 32: KEMEA at 87th Thessaloniki international trade fair

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3. BEIA represented the project at the Gotech World 2023 event in Bucharest, Romania, on 8-9 November 2023, during the event, a booth for the project was used for dissemination and awareness purposes.
4. On the 19th of February 2023, KEMEA represented the FLEXI-cross project at the CERIS Workshop on Innovation for Maritime Situational Awareness and Security, organized by DG-HOME in Brussels. As a BES Cluster member, FLEXI-cross through a project booth was presented to a wide audience of border security practitioners, policymakers, and technology experts. The event served as a key opportunity to disseminate the project's objectives for a flexible, technology-enhanced border-crossing experience and to strengthen synergies in the field of border management.

Figure 33: KEMEA at CERIS 2023

5. The project was presented by BEIA at the InnoPro 2024 Summit, held in Ploiești, Romania, from 31 October to 1 November 2024. Hosted by Wallachia eHub, the event gathered international digital innovation stakeholders. FLEXI-cross showcased using a private booth its advanced solutions for border digitalization, reinforcing its role in the future of smart, secure border management.

6. BEIA participated from the 16th till the 18th of October 2024 in the Romanian security fair, with a private booth, during this event, project flyers were distributed for all booth visitors.

7. On the 24th and 25th of June 2025, The FLEXI-cross project was showcased at the Security Research Event (SRE2025), which was organized by DG HOME of the European Commission. The project's coordinator presented key innovations in biometric authentication, interoperability, and integration with legacy systems, including the Entry/Exit System (EES). Highlights included a visit by European Commissioner and a live demonstration of FLEXI-cross use cases.

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Figure 34: ENG at SRE 2025

2.2.4 Technical workshops

1. On the 4th of December 2023, all project partners participated in a technical workshop to showcase each of their standalone modules and discuss with other partners the objectives and requirements for interoperability between modules.

2. As part of the early validation activities for FLEXI-cross Use Case 2, a workshop was done on site on 17 May 2024 at the Ormenio Border Crossing Point between Greece and Bulgaria with all the border personnel. UC2 Trial leader KEMEA, technical leader WINGS, and operational leader Hellenic Police deployed and tested key technologies, including on-board units with environmental sensors and GPS, Roadside Unit cameras for license plate recognition and behavioural event detection, and a tethered drone for live surveillance. This early deployment marked a critical step in validating the system's readiness for the upcoming full-scale trial.

Figure 35: early validation workshop for UC2

3. On the 30th of October 2024, four pioneering projects came together and organized a joint workshop on how AI is revolutionizing border security. Experts shared their latest

advancements and discussed the impact of AI on maritime awareness, customs, and border control processes. Here's a recap of the key highlights.

Figure 36: joint workshop

4. Technical workshop with external stakeholders during UC1 trial: A technical workshop for Use Case 1 was held during the FLEXI-cross General Assembly in Cyprus (October 2024). The session focused on the Galați Port border scenario, providing participants with a structured walkthrough of the technical architecture, operational scenarios, and integrated tools being prepared for trial deployment.
   The workshop included presentations and demonstrations of key modules such as biometric facial recognition, acoustic anomaly detection, and position prediction tools. Special emphasis was placed on how the modular and mobile design of the FLEXI-cross toolkit supports real-time monitoring of port activities, particularly in situations involving suspicious vessel movements, crew misidentification, and human smuggling attempts.
   Participants from across the consortium and invited external stakeholders, including IGPF representatives, technology developers, and researchers, engaged in live discussions on data flows, sensor integration, and the added value of AR-based operational dashboards. The session helped build technical alignment ahead of the planned UC1 trial and gathered early feedback on interoperability and user interface requirements in port settings.

5. Technical workshop with external stakeholders during UC2 trial: The technical workshop was organized on 8th May 2025 during the UC2 trial at the Regional Integrated Border Management and Migration Center of Orestiada Police Directorate. The aim of the workshop was to present an overview about FLEXI-cross project, specifically focusing on the technical details of UC2 architecture, the scenarios and a demonstration of the technologies used to execute the trial (e.g. HMI and mobile app). The workshop concluded with a presentation of the operational capabilities of HPOL and added-value provided by the FLEXI-cross toolkit. The workshop was attended by over 40 participants, including policymakers (DG HOME), FRONTEX, end-users (Hellenic Police Directorates of Orestiada and Alexandroupolis, Hellenic Customs), industry technologists (WINGS), and researchers (KEMEA).

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Figure 37: Technical workshop with external stakeholders during UC2 trial

6. Technical workshop with external stakeholders during UC3 trial: A separate technical workshop was conducted for Use Case 3 during the same General Assembly in Cyprus (October 2024). This session focused on the Giurgiulești rail border crossing, where FLEXI-cross solutions are being adapted for low-infrastructure and high-traffic rail environments.
   The workshop covered the UC3 system architecture, highlighting how modules such as portable biometric verification, radiation and acoustic threat detection, cargo screening, and AI-driven behavioural analysis are orchestrated through the FLEXI-cross dashboard. Demonstrations emphasized scenarios involving cross-border cargo checks, identification of minors and at-risk individuals, and suspicious passenger behaviour.
   Consortium members, including representatives from BEIA, GIBP, and other technical partners, contributed to discussions on integration challenges, privacy considerations, and practical implementation strategies. The session was instrumental in consolidating the technical approach for UC3, ensuring that the toolkit aligns with stakeholder needs and can be deployed effectively during field testing later in the project timeline.

2.2.5 Physical training

1. The first physical training was done during the showcase that happened in October 2024 in Cyprus, in which all the end users were exposed to the different toolkit modules, and the benefits of each to their daily operations.
2. During the workshop that was organized at the Ormenio Border in 17 May 2024, which is described in section 2.2.4, subsection 2, physical training was done in parallel with the technical work done during the installation of all the HW and SW components.
3. Physical trainings done during the final demonstrations done for each of the 3 UCs

   a. Use case 1:

   The physical preparation for Use Case 1 took place at Galati Port at the beginning of M32 (April 2025). Based on the detailed development of scenarios and prior pre-tests, the main objective
   of this meeting was to train operators on the FLEXI-cross components, conduct tests involving end users and lay the groundwork for component validation using an identified list of KPIs. The functionalities demonstrated during the session included:

- Unusual pattern extraction via the INUS-UPE platform
- Face verification and identification via a mobile app
- outgoing video stream for HOLO,
- Acknowledgement (Ack) and SOS,
- detection of Contraband and smuggling, DangerousSubstance or goods, ClandestineMigrant detection
- Event-Driven Situation Awareness
- Data Export according to the EES and the ETIAS guidelines
- Visual Analytics Dashboard and Organizational Risk Assessment.

b. Use case 2:

The physical training took place at Ormenio BCP at the end of M32 (April 2025). Following the detailed development of the scenarios and the pre-tests conducted in early April 2025, the objective of this meeting was to train the operators on the FLEXI-cross components, run tests with the participation of end-users, and pave the way for validating the components based on a list of identified KPIs. The components which were demonstrated were the following: the wi.MOVE dashboard for predicting security threats and the new WINGS mobile app that allows two-way communication between border travellers and officers to help detect illegal crossings or smuggling.

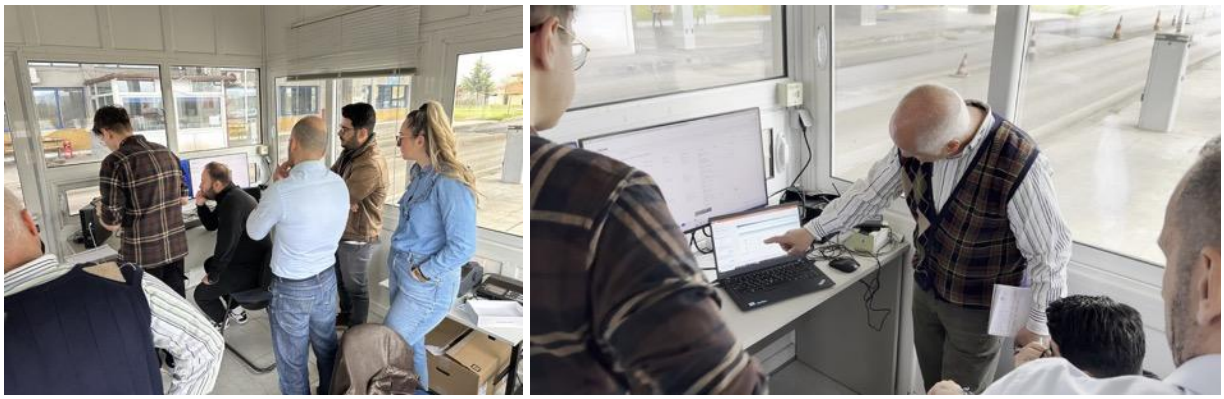

Figure 38: UC2 Physical training

c. Use case 3:

The physical preparation for Use Case 3 took place at Giurgiulesti BCP at the beginning of M32 (April 2025). Based on the detailed development of scenarios and prior pre-tests, the main objective of this meeting was to train operators on the FLEXI-cross components, conduct tests involving end users, and lay the groundwork for component validation using an identified list of KPIs. The functionalities demonstrated during the session included: Control UI UC3, Entities recognition and Tracking, Blockchain connector, Biometric recognition, Position Prediction and Cargo Content Identification.

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Figure 39: UC3 Physical training

2.2.6 Tutorials

To help users get started quickly and use the tools effectively, FLEXI-cross created clear and practical training materials, including tutorials, handbooks, and setup guides. These resources explained how to install the tools, follow step-by-step processes, and use simplified interfaces in real border control situations.

The tutorials were included in the handbooks and shared ahead of webinars. They were designed to be easy to follow—even for users without a technical background—and covered key topics like AI-based threat detection, facial recognition, drone surveillance, and secure identity checks using blockchain.

Alongside scenario slides and system overviews, these materials helped end users understand the tools before hands-on sessions. This made learning faster and gave participants more confidence when using the FLEXI-cross system in real operations.

The details of the tutorials and handbooks can be found in Deliverable D4.6.

2.2.7 Webinars

The FLEXI-cross project conducted a series of internal training webinars between late 2024 and early 2025, each aligned with one of the three operational scenarios: port (UC1), road (UC2), and rail (UC3). These webinars were designed as technical rehearsals and training sessions, aimed at preparing users for field deployment while promoting internal coordination and system refinement.

Each session featured structured walkthroughs of detection workflows, AI-based analytics, and modular tools, accompanied by live demonstrations and Q&A. Key technical components—such as acoustic monitoring, mobile biometric checks, and cargo analysis—were presented using real or simulated data. The webinars also created space for targeted user feedback, especially on interface usability, GDPR compliance, and operational integration.

Though primarily internal, the webinars were instrumental in fostering shared understanding among developers, institutional stakeholders, and end-users, while serving as a foundation for public demonstrations and future cross-project collaboration.

The details of the different webinars can be found in section 4.2

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2.2.8 Symposium/Fair to participate

1. On 31st of January 2023, EBOS participated along with ENG, as a presenter in a virtual and remote event organized by INGENIOUS project for its final event.

   During the event, the project coordinator Mr. Vella reported the challenges and solutions regarding the deployment and continuous validation of a toolkit of innovative border-checking solutions, in real operational environments. The approach toward the project's impact maximization was also presented, with emphasis on the effects on:

   - Information security, while integrating diverse systems
   - Economic, environmental and societal aspects
   - Border-check points/ports operations

2. On 13th and 14th of March 2023, EBOS participated in the Promenade external end user's webinar, aiming to learn more about the Promenade project, during the webinar, valuable experience and knowledge were gained.

3. On 24th of April 2023, HPOL, KEMEA and EBOS participated in the NESTOR demo day and final workshop, the workshop was organized by HPOL and done in KEMEA premises.

4. On 29th till 31st of May 2023, ENG, HPOL and KEMEA participated in RISE SD event that was organized by CERTH, BDI and Satways. RISESD is an international EU research and innovation event in the field of Disaster and Crisis Management, Critical Infrastructure Protection, Fight Crime and Terrorism, Cybersecurity, Border Security and Defence Research.

   Similarly, the participation was posted on the website and the social media pages, there was 3 posts for this participation, first the announcement, the second for the happening now during the time of the event and the last one was post event showing a video for FLEXI-cross project coordinator presenting the project.

5. On 14th and 15th of Jun 2023, ENG represented by Mr Vella presented the project during the Policy seminar, which was organized by DG Home and REA.
   This seminar serves as a platform for newly launched projects to engage with policy stakeholders. The event was a great opportunity for FLEXI-cross project to show how to increase security and reliability of EU border checks for people and goods, while enhancing and improving the border management capabilities, through the development, deployment and validation of a toolkit of innovative border-checking solutions, in real operational environments, addressing road, rail and port borders.
   Participants were organized into thematic areas such as Fighting crime and terrorism & Infrastructure (FCT/INFRA), Strengthened Security Research and Innovation (SSRI), Disaster-resilient societies (DRS), and Border management (BM).
   During the second day of the seminar, FLEXI-cross has participated in an open session with other projects not strictly related areas such as FCT, therefor ENG came in contact with the project coordinators of TENSOR and TENACITY that manages biometric authentication and algorithms respectively for forensic purposes and for fighting crimes committed during cross borders.

6. From 18 until 20 of September 2023, ENG participated in the EAB-RPC event. Refer to section 2.2.1

7. From 27 till 28 of September 2023, ENG participated in a panel within the MEDEA event. During this panel FLEXI-cross project coordinator explained in an interactive manner how the project in contributing to the border security sector.

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8. As a BES cluster member, FLEXI-cross project participated in the final event of METICOS project with the title ""Fostering Innovation in the Sector of Border Management: Where Technology meets Societal Acceptance" giving a speech entitled "Flexible and improved border-crossing experience for passengers and authorities" describing the FLEXI-cross project.

9. On 14 of December 2023, ENG participated in and event in Warsaw with the presence of Frontex under the border management project realm where it presented the FLEXI-cross project and discussed the project consortium, objectives, real use cases, and exploitable assets.

10. From 29 to 31st of May 2024, ICCS participated in the 5th international conference in electronics engineering, information technology & education – EEITE 2024.

2.2.9 Showcase / demonstration spaces

1. Three different demonstrations sessions were done during the Cyprus meeting that was held on the 2nd and 3rd of October, during the 6th plenary meeting.

   The three live demonstrations were conducted in the presence of FRONTEX representatives and the project officer from REA.

   - The first demo highlighted how in real-time terms a UAV enables the extraction of unusual pattern events, also a video streamed to a HOLO lens, while simultaneously sending it to the GUI UI for Border Control Point (BCP) personnel. The demo also tested the real-time user verification/identification app, which successfully relayed events to the GUI UI for visualization.
   - The second demo focused on detecting suspicious driving behaviour, such as U-turns and unlawful parking, with alerts immediately displayed on the GUI UI.
   - The final demo showcased the detection of human trafficking events, which were also reported to the GUI.

   The event concluded with a presentation of the Visual Analytics Dashboard, providing a holistic view of all reported events through charts and graphs to support BCP personnel in making informed decisions. This successful demonstration sets the stage for the next phase, where all components will be fully integrated and tested at real border locations.
2. Three different demonstrations done live for each of the UCs, physically in the corresponding border premises
   - UC1 demonstration: On May 14, 2025, the project partners successfully conducted the Use Case 1 (UC1) demonstration in Galati, Romania, at Spargatorul Perseus on the Danube River. The event involved Engineering (project coordinator), ATG (trial leader), BEIA, ICCS, EBOS, and HOLO (technology providers), who presented the demonstration to WINGS, GIBP, IGPF, and Project Officer.
     The UC1 demonstration provided an opportunity to test internal interoperability among various partner technologies and showcase how they are seamlessly integrated under a common data model. This integration supported different user interfaces, including Engineering's "UC1 Control UI," HOLO's "Augmented Reality Situation Awareness" (ARSA), and EBOS's "Visual Analytics Dashboard" and "Organisation Risk Assessment" modules.
     Specifically, ICCS contributed two modules: the tethered UAS (INUS-UPE) for the extraction of unusual pattern extraction, and the mobile app FACE-VI, which enabled face identification and verification capabilities.
     BEIA demonstrated several modules, including "Entities Recognition and Tracking," "Acoustic Sensing," "Position Sensing," and "Radiation Sensing." These modules

showcased the ability to detect and track vessels from video feeds, identify and locate people on board via fixed microphone hardware, and detect radioactive materials.
During the trials five scenarios were tested:

1. Mismatch between the documents and the person presented at the control
2. One of the crew members leaves the berthed ship, evading the control by bypassing the control team
3. A person attempts to board the ship clandestinely
4. Detection of suspected dangerous material
5. Detection of illegal person on board

The successful UC1 demonstration not only confirmed the seamless interoperability and effectiveness of the integrated technologies in enhancing port security but also highlighted two of Engineering's key modules: the "Role-Based Access Control" (RBAC) system, which ensures users can only see information appropriate to their access level and the sensitivity of the data, and the "Data Export" one, which builds on RBAC to securely extract and share data with external systems. This feature was specifically designed with the European Entry System (EES) in mind.

Figure 40: UC1 demonstration

- UC2 demonstration: The project has successfully conducted a significant demonstration at the Ormenio Border Crossing Point, located near the border between Greece and Bulgaria, from May 6–9, 2025. KEMEA (as trial leader), WINGS (as technical leader) and HPOL (as operational leader) showcased intelligent and dynamic procedures designed to improve the border-crossing experience through the integration of advanced

technologies. Specifically, WINGS added new features to its wi.MOVE product in the framework of FLEXI-cross to showcase cutting-edge solutions for streamlining the road border-check procedure. For the personnel inspecting the cars to take the appropriate action, wi.MOVE also offered a visualization dashboard for the detection and notification of illegal and unauthorized incidents. Predictive analysis of changing security threats is made possible by the wi.MOVE visualization dashboard. To facilitate two-way communication between travelers crossing a border and the administration authorities who monitor for unauthorized entry and/or the transfer of illicit items, WINGS also created and tested a mobile application for the citizens. During the trial, five realistic scenarios were tested with the active participation of our Greek end-users.

1. Truck carrying hidden illegal material
2. Truck carrying hidden migrants
3. Stolen car attempting to cross the border
4. Passenger or driver using forged documents
5. Sudden surge in incoming vehicles addressed by dynamically deploying extra resources

Overall, the demonstration was attended by 40+ people including internal and external stakeholders and policy makers (e.g. HPOL, Hellenic Customs, DG-HOME and FRONTEX).

Figure 41: UC2 demonstration

- UC3 demonstration: On May 15, 2025, the FLEXI-cross consortium successfully executed the Use Case 3 (UC3) demonstration in Galați, Romania, at the Brateș train station. The event was led and coordinated by BEIA, with support from TCCFR, Engineering and EBOS, and attended by observers from WINGS, IGPF (Romanian Border Police), GIBP, HOLO, ICCS, and Project Officer.
  UC3 focused on enhancing border protection in rail cargo environments, aiming to detect unauthorized individuals, identify high-risk cargo, and support decision-making for field teams. The demonstration took place in a realistic operational setting and validated the effectiveness of the FLEXI-cross toolkit in railway surveillance.
  Software Modules Demonstrated (BEIA):

1. Human Trafficking Detection – Used video analytics and audio analysis from fixed surveillance cameras and microphones to detect patterns indicating the presence of concealed individuals or unauthorized access attempts.
2. Illicit Cargo Detection – Combined sensor data, including radiation sensing and video streams, to detect suspicious objects or materials potentially hidden in freight wagons.
3. Multimodal Pattern Detection – Fused inputs from video, audio, and positional sensors to identify unusual patterns or coordinated intrusion attempts.
4. UC3 Control UI – A centralized user interface that presented real-time alerts, sensor outputs, and incident metadata to operators and observers.

Associated Hardware Components:

1. Fixed video surveillance cameras (standard visible-spectrum) for person detection and behavioural monitoring.
2. Directional microphones for detecting specific sound patterns linked to movement or tampering.
3. Radiation sensors for monitoring abnormal radiation levels within or near train wagons.
4. GPS and positional modules used to geolocate detect incidents in the rail yard.

Scenarios Simulated:

1. Mismatch between age and identity documents
2. Cargo from pandemic-affected region
3. Illegal person hiding in or near a train wagon

The successful UC3 demonstration validated the ability of FLEXI-cross technologies to monitor and secure rail cargo infrastructure. It confirmed the modular integration of BEIA's detection modules with Engineering's control architecture and EBOS's data servers, all built on a common data model for real-time, multi-source coordination.

This trial reinforced the potential of FLEXI-cross as a versatile, domain-spanning border surveillance platform, applicable across maritime, land, and rail transport environments. The demonstration was attended by members of Consortium, internal end users (IGPF, GIBP) and representatives of local stakeholders, such as APDM (the Port Administration of the Maritime Danube) and PMG (Primăria Municipiului Galați - Galați City Hall).

Figure 42 UC3 demonstration

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2.2.10 Standards contributions

To provide EC officers with some good practices that have been experienced during the FLEXI-cross project, several methods have been followed since the beginning of the project to illustrate the evidence about policy recommendations. First, a multi-topic set of activities, like synergy webinars and workshops, was organized to gather ideas from different contexts. Secondly, the participation to topic-specific events, like the European Association for Biometrics events, has been very useful to discuss, in a European context, about the main challenges and experiences of the different European actors. The main outcomes of these events have been minutes and the collection of common results within the same topic or between European Research topics like Fight Crime and Terrorism and Border Management.

Four recommendations have been highlighted:

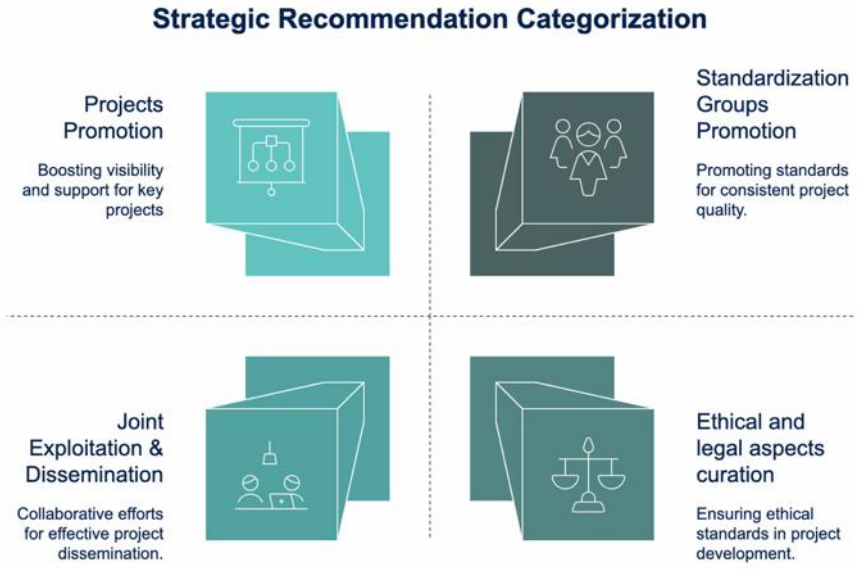

Figure 43: Recommendations overview.

Recommendation 1 – Projects Promotion

- Aim 1: to intensively promote projects clustering activities and participation to synergy activities.
- Aim 2: To actively promote the main results of the projects to identify scientific and innovation findings
- Where and Who was involved: EAB RPC conference, other Biometric conferences, Projects to Policy Seminar, CERIS, brokerage events.
- Target audience: RTO, Academies, Large industries, EC officers and agencies

Recommandation 2 – Joint Exploitation and Dissemination

- Aim 1: to promote European services that support joint exploitation and dissemination. An additional advertisement is needed by increasing awareness of Horizon Results Booster and the related tools. Projects are stimulated to think more in the context of shared results, and possible impacts.
- Where and Who was involved: PPS, Policy Officers and Project officers
- Target audience: RTO, Academies, Large industries, EC officers and agencies, projects facilitating the task

Recommendation 3 – Ethical and legal aspects curation

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- Aim 1: to create more confrontation moments on the AI Act and its application to the Innovation and Research projects
- Aim 2: to explore different nuances of research activities to cover with round tables and FAQ boards all the doubts related to the implementation of AI in the different contexts
- Where and Who was involved: EAB RPC conference, Ethical Experts, EC legal and ethical experts
- Target audience: RTO, Academies, Large industries, EC officers and agencies, projects facilitating the task

Recommendation 4 – Standardization groups and working group promotion

- Aim 1: to organize open consultation with representatives of thematic working groups and standardization bodies where projects can identify the challenges, needs, and findings on potential contribution to standards. More confrontation moments on AI Act and its application to the Innovation and Research projects are needed
- Where and Who was involved: EC officers
- Target audience: RTO, Academies, Large industries, EC officers and agencies, Standardization bodies, working groups

A more detailed standardization procedures, strategy followed for FLEXI-cross and projects contributions are illustrated in section 5 of the deliverable *D4.6 Final commercialisation and impact generation report* (M35).

2.2.11 Policy recommendations

The FLEXI-cross project is a relevant and innovative initiative that aims to improve the security and efficiency of EU border checks for people and goods, while respecting the privacy and rights of the individuals involved. To achieve this, the project needs to comply with the European social and policy regulations that apply to border management and data protection (i.e. The Schengen Borders Code, The General Data Protection Regulation (GDPR), The EU Charter of Fundamental Rights, and The EU Strategy and Action Plan for Customs Risk Management).

Some possible gaps in the European social and policy regulation for border security and privacy have been highlighted engaging with legal experts, regulatory bodies, and stakeholders involved in border management.

This analysis provides valuable insights into potential gaps and challenges that need to be addressed during the development and implementation of the FLEXI-cross solutions. This regulations' overview, gaps, and improvements that took place during the whole project are illustrated in section 4 of the deliverable *D4.6 Final commercialisation and impact generation report* (M35).

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3 FLEXI-cross liaison with other projects, clusters and initiatives

This section presents a list of activities that involved the participation of one or more FLEXI-cross partners in collaborations with relevant EU-funded projects, clusters, and thematic initiatives. These engagements were identified and pursued based on their strategic relevance to the objectives of FLEXI-cross, including interoperability, technological innovation, and alignment with the European Integrated Border Management framework. The selection was informed by a combination of top-down analysis (e.g. EU priorities and Horizon Europe topics) and bottom-up engagement by partners in WP4 and WP5, who contributed domain-specific insights and operational needs. Preference was given to initiatives where there was a clear potential for mutual benefit in terms of technical complementarity, stakeholder access, or policy alignment.

These synergies and collaborations brought valuable input to the project's development. They provided access to complementary technologies (e.g., sensor systems, data fusion platforms, biometric tools), enriched FLEXI-cross's understanding of end-user requirements, and offered practical perspectives on deployment challenges. Additionally, lessons learned from mature or parallel projects (e.g., TENSOR, I-SEAMORE, ODYSSEUS) ensured relevance to real-world border operations and opened a gateway towards possible cross-project system interoperability. Participation in shared events also enhanced project visibility and stakeholder validation.

FLEXI-cross contributed to these collaborations by offering technical insights on modular orchestration, ethical and legal considerations for AI at borders, and user-centric integration strategies. Furthermore, through these activities, the FLEXI-cross partners, were actively engaged in joint dissemination activities and workshops, and shared FLEXI-cross results related to intelligent multimodal threat detection, flexible BCP deployment, data exchange and interoperability, and advanced situation awareness.

3.1 Relevant EU Projects and Initiatives joined

Based on research involving partners from WP4 and WP5, several EU projects and initiatives have been identified as relevant for the FLEXI-cross project, below list is the updated one following the D4.3 deliverable:

- The European Border and Coast Guard Agency (Frontex), which supports the EU Member States and Schengen Associated Countries in managing their external borders and coordinates the operational cooperation on border security and migration management. Frontex also develops and operates various systems and tools for border management, such as the European Border Surveillance System (EUROSUR), the Entry/Exit System (EES), and the European Travel Information and Authorization System (ETIAS). https://home-affairs.ec.europa.eu/networks/ceris-community-european-research-and-innovation-security/thematic-areas/border-management_en
- The EU Integrated Border Management (IBM) concept, which aims to ensure a high level of security and facilitate legitimate travel across the EU external borders, by applying a coordinated approach among all the actors involved in border management, such as border authorities, customs, police, health, and environmental protection. The IBM concept also promotes the use of state-of-the-art technology, interoperable information systems, and risk analysis for border management. https://commission.europa.eu/topics/borders-and-security_en
- The Horizon 2020 Border Security and External Security (BES) research and innovation program, which funds projects that address the challenges and opportunities of border security and management, such as improving border checks, enhancing border surveillance, detecting and preventing cross-border crime and terrorism, and ensuring data protection and privacy. Some

of the projects funded by the BES program are: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/promoting-our-european-way-life/new-pact-migration-and-asylum/well-managed-schengen-external-borders_en

- iBorderCtrl, which developed an intelligent system for faster and more efficient border crossing, using biometric and deception detection technologies. https://home-affairs.ec.europa.eu/news/visual-glimpse-new-2021-2027-migration-borders-and-internal-security-funds-2021-10-21_en
- SMILE, which created a secure and privacy-respecting platform for cross-border identity verification, using blockchain and mobile devices.
- ROBORDER, which designed and tested a system of autonomous robots for border surveillance, using sensors and artificial intelligence.
- #I-SEAMORE is an EU-funded project that aims to develop a holistic and multipurpose platform to support European authorities in maritime surveillance operations, using advanced technologies such as IoT, data fusion, artificial intelligence, and big data analysis. The project involves key European border authorities and end-users, as well as leading technology developers, research organizations, and innovative SMEs. https://inov.pt/en/project/i-seamore/index.html
- ODYSSEUS is an EU-funded project that aims to increase the knowledge on explosive precursors and homemade explosives, and develop effective and efficient prognostic, detection, and forensic tools to improve the capabilities of law enforcement agencies towards the prevention, countering, and investigation of terrorist attacks. The project involves a multidisciplinary consortium of experts from academia, industry, and end-users. https://cordis.europa.eu/project/id/101073910
- BAG-INTEL is an EU-funded project that aims to develop a solution to support the customs teams in tackling the challenge of reidentifying detected suspicious pieces of luggage, for manual inspection. The project will use artificial intelligence, blockchain, and sensor networks to provide real-time data exchange and decision support tools, within the context of advanced detection systems. The project involves a consortium of technology providers and customs agencies. https://cordis.europa.eu/project/id/101073911
- MELCHIOR is an EU-funded project that aims to improve, mature, and demonstrate the novel infrasound interrogation Z-MESMERISE technology in operational environments, including border controls in airports and seaports and land borders, as well as other environments where the technology would be useful, such as crowded events and prisons. The project will use infrasound mechanical impedance interrogation, optionally complemented with other harmless and non-contact technologies, to detect drugs, explosives, weapons, and illicit goods concealed on individuals and in critical cavities of the human body. The project involves a consortium of research institutes, universities, and other technology providers. https://www.prd.frontex.europa.eu/innovation/eu-research/horizon-projects/i-seamore-m67pMT
- NESTOR is an EU-funded project that aims to establish a fully functional next generation holistic border surveillance system, providing pre-frontier situational awareness beyond maritime and land border, following the concept of the European Integrated Border Management. The project will use a combination of technologies, such as satellite imagery, radar, lidar, drones, and artificial intelligence, to provide a comprehensive and integrated picture of the border situation. The project involves a consortium of technology providers, research organizations, and end-users. https://cordis.europa.eu/project/id/101021851
- TENSOR, an EU-funded project that aims to develop a platform to support European authorities in border security and management, using biometric and deception detection technologies. https://cordis.europa.eu/project/id/101073920https://tensor-project.eu/
- TENACITy, an EU-funded project that aims to develop a Travel Intelligence Governance Framework as a holistic approach to crime prevention and training of law enforcement personnel, incorporating advanced tools for processing travel intelligence data. https://cordis.europa.eu/project/id/101074048

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3.2 Collaborative Opportunities and Synergies progress

The FLEXI-cross project had the opportunity to partner with Frontex in sharing insights and best practices related to border management and security. Additionally, there is potential for exploring the seamless integration of FLEXI-cross solutions with Frontex's established systems and tools, including EUROSUR, EES, and ETIAS. Such collaboration aims to bolster the interoperability and compatibility of FLEXI-cross solutions within the broader EU border management framework, ultimately amplifying their adoption and impact.

- The FLEXI-cross project can align with the EU Integrated Border Management concept, by applying a coordinated and holistic approach to border management and security, involving all the relevant actors and stakeholders, such as border authorities, customs, police, health, and environmental protection. The FLEXI-cross project can also leverage the state-of-the-art technology, interoperable information systems, and risk analysis methods promoted by the IBM concept, to ensure a high level of security and facilitate legitimate travel across the EU external borders.

- The FLEXI-cross project can benefit from the Horizon 2020 Border Security and External Security research and innovation program, by learning from the experiences and outcomes of the projects funded by the BES program, such as iBorderCtrl, SMILE, and ROBORDER. The FLEXI-cross project can also seek synergies and complementarities with these projects, by exploring the possibility of combining or integrating their innovative solutions with the FLEXI-cross solutions, to create more effective and efficient border security and management systems.

- The FLEXI-cross project can collaborate with I-SEAMORE to exchange information and best practices on maritime surveillance and border security, and to explore the potential integration of the FLEXI-cross solutions with the I-SEAMORE platform, which uses advanced technologies such as IoT, data fusion, artificial intelligence, and big data analysis. This collaboration can enhance the interoperability and compatibility of the FLEXI-cross solutions with the EU maritime surveillance framework and increase their adoption and impact.

- The FLEXI-cross project can benefit from ODYSSEUS by learning from the experiences and outcomes of the project, which aims to increase the knowledge on explosive precursors and homemade explosives, and develop effective and efficient prognostic, detection, and forensic tools to improve the capabilities of law enforcement agencies towards the prevention, countering, and investigation of terrorist attacks. The FLEXI-cross project can also seek synergies and complementarities with ODYSSEUS, by exploring the possibility of combining or integrating their innovative solutions for border security and management.

- The FLEXI-cross project can collaborate with BAG-INTEL to exchange information and best practices on customs and luggage inspection, and to explore the potential integration of the FLEXI-cross solutions with the BAG-INTEL solution, which uses artificial intelligence, blockchain, and sensor networks to provide real-time data exchange and decision support tools, within the context of advanced detection systems. This collaboration can enhance the efficiency and accuracy of customs and luggage inspection and reduce the risks of smuggling and trafficking.

- The FLEXI-cross project can benefit from MELCHIOR by learning from the experiences and outcomes of the project, which aims to improve, mature, and demonstrate the novel infrasound interrogation Z-MESMERISE technology in operational environments, including border controls in airports and sea-ports and land borders, as well as other environments where the technology would be useful, such as crowded events and prisons. The FLEXI-cross project can also seek synergies and complementarities with MELCHIOR, by exploring the possibility of combining or integrating their innovative solutions for border security and management.

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- The FLEXI-cross project can collaborate with NESTOR to exchange information and best practices on border surveillance and situational awareness, and to explore the potential integration of the FLEXI-cross solutions with the NESTOR system, which uses a combination of technologies, such as satellite imagery, radar, lidar, drones, and artificial intelligence, to provide a comprehensive and integrated picture of the border situation. This collaboration can enhance the effectiveness and reliability of border surveillance and situational awareness and improve the border management capabilities.

- The FLEXI-cross project can collaborate with the TENSOR project to exchange information and best practices on border security and management, and to explore the potential integration of the FLEXI-cross solutions with the TENSOR platform, which uses biometric and deception detection technologies. This collaboration can enhance the accuracy and reliability of border checks and identity verification and reduce the risks of fraud and deception. The FLEXI-cross project can benefit from the TENSOR project by learning from the experiences and outcomes of the project, which aims to develop a platform to support European authorities in border security and management, using biometric and deception detection technologies. The FLEXI-cross project can also seek synergies and complementarities with the TENSOR project, by exploring the possibility of combining or integrating their innovative solutions for border security and management.

3.3 Joint Activities progress

As anticipated in the deliverable *D4.3 Intermediate dissemination, communication, capacity building and training activities*, the FLEXI-cross project started a synergy with the TENSOR project. TENSOR (Reliable biomeTric tEhNologies to asSist Police authorities in cOmbating terrorism and oRganized crime) is an Innovation Action funded by European Union under Horizon Europe research and innovation program (HORIZON-CL3-2021-FCT-01-05) via grant agreement No. 101073920.
A Memorandum of Understanding beetween FLEXI-cross and TENSOR has been signed the 12/01/2024.
Another Memorandum of Understanding is in progress regarding joint communication and dissemination activities with the following EU-funded projects:

- I-SEAMORE is a Horizon Europe funded project that aims to develop an integrated Ecosystem composed of an advanced platform solution to host and manage the operation of several innovative assets, services and systems for maritime operations. It aims to provide European Authorities with increased situational awareness and operational capabilities for Maritime surveillance operations resorting to aerial and water surface support. I-SEAMORE includes the modernization and/or development of a set of services and tools that will enable the Maritime Operation Centers to take advantage of the use of heterogeneous data sources as well as data and information processing mechanisms.

- ODYSSEUS is a Horizon Europe funded project that aims to enhance the experience of border crossing for travelers and border authorities' staff while keeping secure and tracking the movements across external water and land borders of the EU. This initiative aims to protect passengers' fundamental rights while promoting the security and integrity of European space by minimizing unauthorized cross-border movements of people and goods. ODYSSEUS also intends to optimize the safety of customs and supply chain by improving the prevention, detection, deterrence, and fight against crime involving goods flows across EU external border crossing points and through the supply chain, reducing disruption to trade flows.

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- BAG-INTEL The main challenge for the customs operation is to re-identify the luggage after the passenger has picked it up from the carousel and proceeded toward the exit. And with the increase in the volume of passengers arriving by air at inland border airports, the need for increased efficiency of baggage customs control continues to grow. BAG-INTEL's envisioned solution to support the customs teams in efficiently tackling such challenges will involve high-resolution cameras and robust AI, which will provide an end-to-end continuous reidentification of the luggage. The solution will help to ensure that all baggage is scanned and that the suspicious luggage is kept track of so that the customs staff can easily find it and manually inspect it.

- MELCHIOR is an EU funded Innovation Action project which aims to improve, mature and demonstrate the novel infrasound interrogation Z-MESMERISE technology in operational environments including border controls in airports and seaports and land borders as well as other environments where the technology would be quite useful like crowded events and prisons. In a nutshell, MELCHIOR aims to improve substantially a novel technology for fast detection of drugs, explosives, weapons and illicit goods concealed on individuals and in critical cavities of the human body based on infrasound mechanical impedance interrogation, optionally complemented with other harmless and non-contact technologies.

- NESTOR H2020 European Project aims to demonstrate a fully functional next generation holistic border surveillance system providing pre-frontier situational awareness beyond maritime and land border following the concept of the European Integrated Border Management. NESTOR will validate and demonstrate its applied solutions in real operational scenario trials together with national Law Enforcement Agencies, Border authorities and practitioners to certify their efficiency. The system will be evaluated through three successive releases in three corresponding trials.

- METEOR (Rapid, Portable and Reliable Cargo Screener) is an EU-funded innovation project aimed at transforming how authorities detect illicit drugs and other threats hidden in cargo containers. The project is developing a breakthrough vapor screening technology based on ion mobility chemical fingerprinting, enabling rapid, non-intrusive detection of concealed substances at ports, borders, and other high-traffic logistics hubs. Unlike conventional detection systems, the METEOR analyzer is designed to be portable, fast, and user-friendly, providing reliable results within minutes and without needing to open or unload containers. The solution combines advanced gas-phase sampling, atmospheric pressure photoionization (APPI), and a novel multi-detector ion mobility system to identify target substances with high sensitivity, even at trace levels. Through collaboration with customs agencies, law enforcement, and research partners across Europe, METEOR is aligning its development with real-world operational needs. The project supports EU priorities in border security, drug trafficking prevention, and the deployment of next-generation screening tools that enhance safety while facilitating legitimate trade.

- CONNECTOR's vision is to contribute to European Integrated Border Management (EIBM) and the EU Customs Action Plan by addressing the need for close cooperation between Customs, Border and Coast Guard Authorities in the context of the challenging environment of border control, both currently and in the future. This can be met by further involving Customs in the Common Information Sharing Environment (CISE) network and the Enhanced Common

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Information Sharing Environment (e-CISE). To meet this need, CONNECTOR is developing the Customs Extended Common Information Sharing Environment (CE-CISE).

The below Table 10 shows all the FLEXI-cross joint activities that have taken place:

Table 10: FLEXI-cross and joint activities with others EU-funded projects

	Type of event	Description	Dates
1	Workshop	Concept for synergy workshop with syster projects I-SEAMORE, FLEXI-cross, ODYSSESU, PROMENADE, BAG-INTEL	12/01/2024
2	Workshop	Synergy workshop among TENSOR, EITHOS, FLEXI-cross, ODYSSEUS projects	12/3/2024
3	Conference	EAB RPC	25/09/2024
4	Workshop	Workshop on Ethical and Societal Implications of Security Technologies in Border Management (I-SEAMORE, ODYSSEUS, FLEXI-cross, BAG-INTEL projects)	20/11/2024
5	Workshop	Unobtrusive Technologies for Secure and Seamless Border Crossing for Travel Facilitation - New solutions in Border Management (ODYSSEUS, BAG-INTEL, FLEXI-cross, I-SEAMORE projects)	11/12/2024
6	Event	Detection Hub	29/01/2025
7	Workshop	FCT and BM projects clustering workshop (FLEXI-cross, TENSOR, ODYSSESU, TENACITy projects)	01/04/2025
8	EVENT	European Commission Security Research Event (SRE)	24-25/06/2025

3.4 Joint Activities progress

3.4.1 Rational of Relevant EU Projects and Initiatives to the FLEXI-cross Project

According to section 3.1, the FLEXI-cross project stands to benefit significantly from synergies, complementarities, and collaboration with several ongoing and past EU-funded projects and initiatives in the field of border security, surveillance, and migration management. These collaborations will enhance the relevance, interoperability, and impact of FLEXI-cross solutions within the broader EU border management framework.

1. Core Institutional and Strategic Frameworks

- European Border and Coast Guard Agency (Frontex)

  Frontex supports EU Member States and Schengen Associated Countries in managing their external borders, coordinating operational cooperation, and managing border and migration systems. It operates key systems such as:
  - EUROSUR – European Border Surveillance System
  - EES – Entry/Exit System

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- ETIAS – European Travel Information and Authorization System
  Through potential collaboration, FLEXI-cross can align with Frontex standards and systems to boost interoperability and real-world applicability.

- EU Integrated Border Management (IBM) Concept

  The IBM framework promotes a coordinated, multi-agency approach involving border police, customs, health, environmental protection, and others. It encourages the use of interoperable IT systems, advanced risk analysis, and state-of-the-art technology. FLEXI-cross can align its methodologies with the IBM concept to ensure both high security and efficient border operations.

- Horizon 2020 – Border and External Security (BES) Program

  This program supports innovative projects that address cross-border crime, terrorism prevention, border surveillance, identity verification, and data protection. FLEXI-cross can leverage learnings, datasets, and tested innovations from past projects for more impactful solution development.

2. Key Projects and Their Contributions

- iBorderCtrl
  Developed an intelligent system to streamline border crossings using biometric and deception detection technologies. FLEXI-cross can draw from its technical advancements to improve identity verification processes.

- SMILE
  Created a secure, privacy-preserving platform for cross-border identity verification using blockchain and mobile technology. Its privacy-first approach is relevant for FLEXI-cross's ethical and legal compliance.

- ROBORDER
  Developed an autonomous robotic surveillance system using AI and sensors for land and maritime borders. FLEXI-cross can explore integration or interoperability with these robotic units for situational awareness.
- I-SEAMORE
  A maritime-focused platform combining IoT, AI, big data, and data fusion for surveillance. FLEXI-cross can build upon this project to expand into maritime border security domains.

- ODYSSEUS
  Focused on explosives precursor detection and forensic tools. FLEXI-cross could benefit by integrating ODYSSEUS' tools into border checks to enhance threat detection capabilities.

- BAG-INTEL
  Supports customs by enabling re-identification of suspicious luggage using AI, blockchain, and sensor networks. Joint use cases with FLEXI-cross could improve customs efficiency and reduce false positives.

- MELCHIOR
  Develops and tests Z-MESMERISE infrasound technology for non-contact detection of concealed items on individuals, including in airports, seaports, and prisons. FLEXI-cross can explore integration to broaden its detection toolkit.

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- NESTOR
  Develops a next-generation border surveillance system combining satellite imagery, radar, lidar, drones, and AI for situational awareness. NESTOR and FLEXI-cross can collaborate on multi-source data fusion and intelligence processing.

- TENSOR
  A platform using biometrics and deception detection to support border security operations. FLEXI-cross can benefit from TENSOR's validated approaches to improve screening reliability and fraud detection.

- TENACITy
  Focuses on developing a Travel Intelligence Governance Framework, offering tools for crime prevention, data processing, and law enforcement training. FLEXI-cross can adopt insights from TENACITy for advanced traveler risk profiling and policy compliance.

3.4.2 Rational of collaborative opportunities and synergies progress

According to section 3.2, the FLEXI-cross project presents a strong opportunity to collaborate with Frontex, sharing insights and best practices in border management and security. A key area of cooperation lies in exploring the seamless integration of FLEXI-cross solutions with existing Frontex systems and tools, including EUROSUR, EES, and ETIAS. This partnership aims to enhance interoperability and compatibility, aligning FLEXI-cross technologies with the broader EU border management ecosystem, thus facilitating adoption and maximizing impact.

1. Alignment with the EU Integrated Border Management (IBM) Concept

FLEXI-cross can align with the EU Integrated Border Management (IBM) approach by promoting a coordinated and holistic strategy to border security. This includes active collaboration among various stakeholders—border authorities, customs, police, health, and environmental agencies—to ensure both high security standards and facilitation of legitimate cross-border movement. Leveraging state-of-the-art technologies, interoperable systems, and advanced risk analysis methods promoted under the IBM concept, FLEXI-cross contributes to a more efficient and secure EU border framework.

2. Synergies with Horizon 2020 Border Security and External Security (BES) Projects

The FLEXI-cross project can benefit significantly from the Horizon 2020 BES research program by building on the outcomes of pioneering projects such as:

- iBorderCtrl: Smart border control solutions using biometric verification.
- SMILE: Seamless biometric border crossing for low-friction travel.
- ROBORDER: Autonomous border surveillance using unmanned systems.

FLEXI-cross can identify complementarities, explore interoperability, and potentially integrate solutions from these projects to enhance the overall effectiveness of its border security technologies.

3. Collaboration Opportunities with Related EU Projects

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- I-SEAMORE: Joint work on maritime surveillance and border security using IoT, data fusion, AI, and big data. Integration with the I-SEAMORE platform could boost maritime domain awareness and interoperability.

- ODYSSEUS: By drawing on ODYSSEUS' expertise in explosive precursors detection and forensic tools, FLEXI-cross can improve its capability to prevent and investigate threats at borders. Combined efforts could lead to more comprehensive and integrated threat detection systems.

- BAG-INTEL: Collaboration could enhance customs and luggage inspection using AI, blockchain, and sensor networks. Integration of FLEXI-cross solutions can improve real-time data exchange, reduce smuggling risks, and optimize inspection efficiency.

- MELCHIOR: Synergies with MELCHIOR, which focuses on infrasound interrogation technologies (Z-MESMERISE), could extend FLEXI-cross capabilities to non-intrusive detection in border control environments including airports, seaports, and land borders.

- NESTOR: Sharing methodologies on border surveillance and situational awareness using satellite imagery, radar, lidar, drones, and AI, FLEXI-cross can complement and integrate with NESTOR systems to enhance real-time border monitoring and decision-making support.

- TENSOR: Both projects can collaborate on biometric and deception technologies. Leveraging the TENSOR platform's advancements, FLEXI-cross can refine its identity verification tools and reduce fraud risks. The exchange of best practices can ensure greater accuracy and trustworthiness of border checks.

3.4.3 Rational of joint activities

According to section 3.3, the FLEXI-cross project has made significant progress in establishing joint activities and synergies with several EU-funded initiatives under the Horizon Europe and Horizon 2020 program. These collaborations aim to maximize the impact, visibility, and interoperability of the FLEXI-cross solutions within the broader European border management and security ecosystem.

1. Established Collaboration with TENSOR

A major milestone in 2024 was the initiation of a formal synergy with the TENSOR project *(Reliable biomeTric tEhNologies to asSist Police authorities in cOmbating terrorism and oRganized crime)*. TENSOR is funded under the HORIZON-CL3-2021-FCT-01-05 topic via Grant Agreement No. 101073920.

A Memorandum of Understanding (MoU) between FLEXI-cross and TENSOR was signed on 12 January 2024, marking the beginning of formal cooperation on dissemination, technical knowledge exchange, and joint events.

2. Ongoing Collaboration Negotiations

FLEXI-cross is also in the process of finalizing Memoranda of Understanding for joint communication and dissemination activities with the following Horizon Europe and Horizon 2020-funded projects:

- I-SEAMORE: Developing an integrated ecosystem and platform for maritime operations, supporting situational awareness through advanced aerial, water surface assets, and data fusion technologies.

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- ODYSSEUS: Aiming to secure and streamline border crossings while protecting fundamental rights. The project also focuses on enhancing supply chain security and crime prevention related to goods and people crossing EU external borders.

- BAG-INTEL: Tackling challenges in customs baggage re-identification using AI, high-resolution cameras, and sensor networks to improve customs control efficiency in high-volume airports.

- MELCHIOR: Maturing the Z-MESMERISE infrasound interrogation technology for non-contact detection of concealed illicit materials in operational settings like borders, ports, and crowded venues.

- NESTOR: Demonstrating a next-generation holistic border surveillance system, using satellites, radar, lidar, drones, and AI to improve pre-frontier situational awareness.

- METEOR: Innovating a portable vapour screening system for rapid, non-intrusive detection of illicit substances in cargo containers, based on ion mobility chemical fingerprinting.

- CONNECTOR: Contributing to the European Integrated Border Management by enhancing information sharing between Customs, Border, and Coast Guard authorities through the CE-CISE (Customs Extended Common Information Sharing Environment).

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4 FLEXI-cross Capacity Building and training activities

4.1 Capacity building activities

Capacity building within the FLEXI-cross project was strategically designed to support the deployment, integration, and sustainable adoption of next-generation border security technologies. It involved a structured blend of user engagement, technical coordination, ethical alignment, and institutional collaboration. These activities ensured that end-users and partner institutions were not merely recipients of innovation, but co-creators and competent implementers.

4.1.1 Stakeholder Engagement through Event Participation

Throughout 2023 and early 2024, FLEXI-cross steadily expanded its outreach and stakeholder engagement through a carefully curated series of European events. These engagements were designed to build momentum with security researchers, policy communities, and technology integrators, ensuring that the project's modular solutions were positioned at the forefront of next-generation border management.

From the outset, the FLEXI-cross project understood that creating next-generation border security technologies required more than technical innovation; it demanded public trust, institutional alignment, and real-world validation. Recognizing this, the consortium launched a sustained campaign of stakeholder engagement through strategic participation in high-impact national and international events spanning 2023 to 2025. These engagements were carefully selected not merely as platforms for dissemination, but as structured opportunities for dialogue, collaboration, and capacity building with key players from across the European border security landscape.

Every event attended by the project served as a gateway to deeper institutional coordination. Presentations, technical showcases, and one-on-one discussions were tailored in advance to resonate with their intended audiences—ranging from border and customs authorities to digital innovation clusters, and EU regulatory bodies. Rather than offering static overviews, FLEXI-cross brought its technologies to life through scenario-based demonstrations. These were designed to foster real-time feedback, stress-test operational relevance, and reveal new applications in both security and civilian environments.

In early appearances, the project engaged with various categories of stakeholders to present its integrated situational awareness and biometric systems. The discussions centered around cross-border coordination and the role of AI in improving the resilience of transport nodes and border crossings. Events like global IoT summits, IEEE conferences, and urban innovation expos offered the chance to bridge discussions between cybersecurity experts, municipal authorities, and national policymakers.

What made these participations impactful was the careful preparation behind them. For each engagement, the project team invested time in understanding the profile and expectations of attending stakeholders. Background briefings were developed to tailor messaging to different audiences. Project partners coordinated internally to ensure consistency in messaging, while also adapting dynamically to the interests raised during the attended events.

At national-level events, particularly in Romania, Greece, and Moldova, the project deepened its relationships with the representative authorities taking part in the use cases, laying the groundwork for pilot adoption and real-world testing. These interactions allowed the FLEXI-cross toolkit to be presented not just as a technology portfolio, but as a potential asset in national and regional security strategies. In larger European trade fairs and smart city congresses, the project showcased how its modular systems could scale to industrial settings, logistics networks, or integrated urban surveillance infrastructures.

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The ethical and standardization components of the project were also reinforced during the presentation of the project's scope and objectives. At several events, the team engaged with other participants on subjects such as data protection, algorithmic transparency, and secure-by-design architecture. This helped align FLEXI-cross with relevant regulatory frameworks while building trust among audiences concerned with responsible AI deployment.

This coordinated strategy of engagement had yielded a good impact. More than just an R&D initiative, FLEXI-cross emerged as a well-prepared and institutionally embedded actor (through the well-balanced representation of different categories of stakeholders within the consortium) trusted for its technological promise, operational readiness, and commitment to ethical, scalable innovation.

4.1.2 Strategic Engagement and Early User Involvement

The definition of FLEXI-cross's three pilot use cases—UC1 at Galați Port, UC2 at the Ormenio Road Border Crossing, and UC3 along the Romania–Moldova Railway Corridor—did not follow a traditional top-down design methodology. Instead, they were shaped through an iterative, co-creative process in close collaboration with national and local border authorities, customs officials, and security stakeholders directly operating at each site.

This approach ensured that each use case reflected real-world operational needs, challenges, and constraints, rather than abstract or idealized research scenarios. From the outset, the consortium engaged stakeholders from the three pilot locations through workshops, interviews, and planning sessions. These engagements helped surface key insights into the local infrastructure limitations, procedural bottlenecks, and specific threat vectors that border agents encounter in daily operations.

At Galați Port (UC1), for example, Romanian maritime and port security agencies highlighted issues around monitoring cross-border cargo flows and detecting irregular activity in a high-traffic, multi-modal logistics environment. This informed the decision to deploy solutions such as acoustic anomaly detection, radiation sensors, and dashboard-enabled situational awareness systems tailored to the port setting.

In UC2 at Ormenio—Greece's easternmost road border—the Greek Police and customs officials helped identify the need for enhanced identity verification, rapid vehicle scanning, and mobile surveillance in remote, infrastructure-light environments. Their input led to the integration of mobile biometric kits, edge-enabled vehicle inspection modules, and lightweight UAV deployments that could operate with minimal fixed installations.

Meanwhile, at UC3 along the Romania–Moldova railway line, border protection stakeholders flagged the challenges of monitoring transiting trains in dynamic rural terrain, where infrastructure is sparse and delays in detection can be costly. These insights helped shape the deployment of ruggedized mobile kits, including acoustic sensors and radiation sensors, and interoperable data exchange platforms adapted to rail-based border control.

This bottom-up, user-driven approach allowed the project to align its technology development not only with technical requirements but also with institutional practices and legal realities. It also fostered early ownership among end users, increasing the likelihood of successful validation and eventual adoption of the solutions being tested. The co-creation process helped ensure that FLEXI-cross technologies are not imposed upon operational contexts, but rather embedded within them, reinforcing both their relevance and long-term sustainability.

4.1.3 Institutional Learning and Inter-Project Collaboration

Throughout the duration of the FLEXI-cross project, regular plenary meetings and technical reviews served as milestones for fostering collaboration, transparency, and cohesion across the diverse

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consortium. These meetings were not only formal checkpoints, they acted as working forums where technical teams, policy experts, end users, and dissemination leads could align their efforts and resolve challenges in real time. A notable example was the 6th Plenary Meeting, held in Cyprus in October 2024, which brought together over 30 representatives from partner organizations. The event provided a structured environment for deep technical exchanges on system integration, data pipeline validation, and cross-border testing plans.

These plenaries also devoted substantial attention to topics such as AI governance, ethics, and regulatory alignment, recognizing the complex socio-technical environment in which the FLEXI-cross toolkit would eventually operate. Working groups addressed issues ranging from GDPR-compliant system design and data anonymization protocols, to harmonizing multi-sensor platforms with legal requirements in different national jurisdictions. By opening space for structured dialogue on these dimensions, the plenary meetings enabled the project to maintain a shared ethical and technical baseline, despite differences in national security policies, infrastructure maturity, and stakeholder expectations.

Complementing these internal alignment efforts, FLEXI-cross also positioned itself as a convener of cross-project dialogue on AI governance and ethical innovation. In April 2025, the project co-organized a Synergy Workshop on AI governance in border security in partnership with fellow EU-funded projects TENSOR, ODYSSEUS, and TENACITy. This high-impact event brought together experts in AI ethics, cybersecurity law, public administration, and operational technology to examine shared challenges facing the next generation of border technologies.

Discussions at the workshop focused on practical barriers to ethical AI deployment, including bias detection in biometric systems, interoperability across heterogeneous infrastructures, and the need for transparent decision-making in automated border controls. Participants also explored how technical safeguards, such as explainable AI (XAI) modules and audit trails, could be operationalized in high-risk environments without compromising performance.

One of the major outcomes of the workshop was a decision to draft a Joint White Paper, consolidating the group's shared insights and recommendations for future research, policy guidance, and standardization. This paper is intended to serve not only as a reference for the projects involved but also as a contribution to the wider European dialogue on trustworthy AI, particularly within the security domain. Through these efforts, FLEXI-cross strengthened its leadership in ethical capacity building, ensuring that its innovations are both technically robust and socially responsible.

4.1.4 Capacity Building Through Continuous Feedback and Adaptation

- End-User Feedback:

  At each demonstration, internal end users tested the tools, offering direct feedback on interfaces, system responsiveness, and reliability under usage. These inputs were critical to adapting the technology to the real-world working conditions and capabilities of personnel.

- Knowledge Dissemination via Newsletters, social media and Press Releases (see section 2.1.3):

  Regular newsletters and press releases documented progress, technologies, and insights in an accessible format for EU stakeholders, border agencies, and the public. They functioned as informal training tools to raise awareness and literacy in emerging technologies.

4.1.5 Exchange of information with relevant stakeholders

FLEXI-cross actively fosters a structured, multidirectional flow of information among its internal stakeholders, including technology developers, integration partners, field operators, legal experts,

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and institutional end users—to ensure that all components of the system are designed, implemented, and validated in alignment with real operational demands. This exchange is a deliberate and foundational strategy embedded in the project's implementation methodology.

Rather than treating system design as a linear engineering process, FLEXI-cross embraces an iterative, co-creative development cycle. Insights gathered from national border authorities, pilot site coordinators, and data protection specialists feed directly into technical refinement loops. Likewise, updates from the R&D teams regarding software capabilities, hardware configurations, and integration constraints are shared transparently with operational stakeholders, ensuring that expectations remain aligned throughout the project's lifecycle.

These internal dialogues have facilitated through a mix of formal channels—such as plenary meetings, task-specific working groups, and internal validation reviews—and informal mechanisms, including technical meetings, user feedback sessions, and ongoing communication via collaborative platforms. Each of these interaction points plays a role in stress-testing assumptions, identifying implementation risks early, and surfacing opportunities for optimization.

For example, the configuration of the exploited systems in all UCs was refined regarding field conditions—such as bandwidth availability, response time constraints, and fine-tuned considering user friendly aspects. Similarly, the design of the system dashboards was informed by consultations with command center operators to ensure that visualizations and alerts support decision-making under pressure.

This multidirectional information exchange model also plays a critical role during the validation and demonstration phases of the project. As pilot activities evolved, continuous feedback from field tests is looped back into system development and ethics evaluation. This approach ensured that both technical interoperability (across borders, sensors, and software layers) and institutional acceptability (including legal compliance, usability, and trust) were continuously assessed and improved.

During the internal training sessions (detailed in sub-section 4.2), project teams presented detailed demonstrations of how diverse surveillance data streams, including acoustic signatures, visual tracking, biometric data, and vehicle inspection records—could be securely collected, processed, and exchanged in near real time. This capability enables seamless integration with national and European command and control centers, enhancing situational awareness and cross-border collaboration.

Specific measures were also taken to safeguard data protection, including:

- Implementation of role-based access controls for different authorities and operational users.
- Encryption and secure transmission protocols compliant with GDPR and national legislation.
- Configurable thresholds and alerts to limit data exposure to only what is operationally necessary.

In addition to the technical components, the project organized regular coordination meetings (at WP level and full consortium level, as part in WP6 – Project Management) and feedback loops to gather operational input and ensure that the solutions remain fit for purpose. This sustained engagement-built trust among internal stakeholders, facilitated early identification of potential compliance issues, and strengthened readiness for the upcoming real-life trials.

4.1.6 Communication with other relevant EU projects and initiatives

FLEXI-cross maintains active liaisons with similar Horizon Europe and Horizon 2020 projects focusing on border security, situational awareness, and AI ethics (e.g., iBorderCtrl, SMILE, BorderUAS, TRESSPASS, and others). This structured communication helps to ensure that the project contributes to and benefits from the broader European innovation ecosystem in the border management domain. Details of the relevant EU project and initiatives are described in section 3.

This exchange takes place through multiple channels, including:

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- Joint dissemination activities, such as workshops, conferences, and project clustering events, where project results, technical challenges, and policy implications are shared with peers and EU institutions. Participation in these events not only raises awareness of FLEXI-cross solutions but also reinforces alignment with evolving European priorities in integrated border management.
- Exchange of lessons learned, especially around critical topics such as compliance with the AI Act, explainability of risk assessment models, human factors and user acceptance, and best practices for ensuring compliance with the General Data Protection Regulation (GDPR) in complex, multi-sensor environments. These insights inform continuous improvement of FLEXI-cross modules and support the development of common approaches across projects.
- Coordination of technical standards (detailed in D4.6), including sensor data formats, communication protocols, and interoperability requirements, to avoid duplication of effort and enable seamless integration with other EU-funded systems and legacy infrastructures operated by border authorities. For example, project teams coordinate the alignment of data-sharing frameworks with emerging interoperability specifications under the EU interoperability architecture.

FLEXI-cross pursued multi-level collaborations to ensure operational viability and interoperability:

- Coordination with the Romanian Border Police, Greek Hellenic Police, Moldovan Border Service, and Customs bodies informed legal-parametric configurations for ID verification and threat detection.
- EU-level oversight included regular briefing and reporting to Horizon Europe officers and technical discussions with eu-LISA representatives to align posterior integration with EES, VIS, and SIS systems.
- Cross-project synergy through active presence in thematic clusters: FCT & BM workshops in March 2024, AI operations workshop in October, and the April 2025 Synergy Workshop co-hosted with TENSOR, ODYSSEUS, and TENACITy resulted in co-authorship of a forthcoming white paper on ethical AI governance.

This integration into EU and peer ecosystems elevated FLEXI-cross's credibility and helped align development with EU strategic frameworks.

4.1.7 Logistics, preparation, and coordination with various authorities across countries to ensure high-level, standards-compliant pilot tests

Preparation for the pilot tests was extensive, multidisciplinary, and required sustained coordination among multiple actors to ensure that the solutions could be deployed under realistic operational conditions while fully complying with EU standards and national regulations.

Specifically, the preparation involved:

- Coordination with port, road, and rail authorities in Romania, Greece, and Moldova to align deployment plans with real-world operational schedules and infrastructure availability. This included identifying suitable test sites, arranging access permissions, and integrating pilot activities into daily workflows without disrupting ongoing border operations. Regular meetings and planning workshops were held with site managers, security staff, and technical leads to anticipating practical challenges and defining contingency measures.
- Technical rehearsals of all hardware and software components—such as acoustic sensors, biometric scanners, mobile and desktop applications, and command-center dashboards.

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These staged demos, showcased during the training webinars, allowed project teams and operational users to validate sensor placements, network connectivity, and system responsiveness under simulated conditions. This step was critical to identify and resolve interoperability issues and to optimize performance before live deployment.

- Validation of compliance with EU and national regulations, covering data protection, health and safety, and operational procedures. Comprehensive GDPR impact assessments were conducted to ensure personal data collected during the pilots—such as facial images, biometric records, and vehicle information—would be processed lawfully and transparently. Special attention was given to defining user roles, data retention policies, and consent procedures where applicable.
- Development of supporting materials to standardize procedures and facilitate consistent execution across sites. These included scenario slides detailing step-by-step workflows, training booklets for end-users and observers, technical protocols for sensor calibration and troubleshooting, and checklists for pre-deployment readiness reviews.
- In addition, the consortium established lines of communication to coordinate among project partners and site authorities. This ensured that any operational, legal, or technical issue could be promptly addressed before and during the pilots.
- Comprehensive efforts ensured the pilots would be executed to a high operational standard, in line with both EU-level expectations and the specific requirements of each participating country. The systematic approach to preparation reinforced the project's commitment to credibility, compliance, and real-world usability of the FLEXI-cross solutions.

4.1.8 Activities on Social and Policy Regulation Integration in FLEXI-cross

The FLEXI-cross project undertook research focused on ensuring that its border security innovations were fully aligned with European legal, social, and ethical standards. This effort began with foundational prospection into the core regulatory frameworks governing EU border management and data protection, and evolved into a dynamic process of policy integration, and solution-specific legal customization.

- Phase 1 – Regulatory Landscape Review

A thorough desk research phase was conducted to identify and review the main EU legal instruments relevant to border control and personal data use. This included the Schengen Borders Code, General Data Protection Regulation (GDPR), EU Charter of Fundamental Rights, EU Strategy for Customs Risk Management, and newer frameworks such as the proposed AI Act and the New Pact on Migration and Asylum.

This legal scoping allowed the consortium to establish baseline compliance criteria and understand the legal obligations and rights implications embedded in cross-border operations, biometric processing, real-time surveillance, and data exchange.

- Phase 2 – Gap Analysis and Risk Identification

Building on the legal review, the project team identified several critical gaps in current EU policy landscapes that could hinder the safe and lawful deployment of advanced border technologies. These included:

- A lack of harmonized biometric standards
- Unclear rules for AI, AR, and blockchain in border contexts
- Gaps in cross-border data sharing regulation
- Weak provisions for situational awareness and privacy-safe threat prediction

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- Phase 3 – Legal Integration into FLEXI-cross Solutions

The findings from the gap analysis were translated directly into solution development. A detailed mapping process was conducted, linking each FLEXI-cross module to the most relevant regulatory anchor points. For example:

  - Biometric tools (S1–S3) were aligned with GDPR and EES standards, embedding consent workflows and audit capabilities.
  - Risk assessment and visual analytics systems (S5–S6) were developed with transparency requirements and user access controls to comply with the EU Security Union Strategy.
  - Surveillance platforms and real-time analytics tools (S7–S9) incorporated human-in-the-loop mechanisms. Blockchain-enabled cargo tracking (S12) was designed to anticipate forthcoming EU regulations on digital trade and tamper-proof customs verification.

This legal customization ensured that each tool not only complied with existing laws but also contributed meaningfully to advancing best practices and policy innovation.

- Phase 4 – Operational Readiness and Documentation

The final phase of work focused on consolidating legal compliance into tangible deliverables and preparing the project for full-scale validation. Each solution underwent internal reviews for GDPR alignment, and where applicable, Data Protection Impact Assessments (DPIAs) were conducted. Legal and ethical features—such as traceability, user consent, explainability, and role-based access—were embedded across the system architecture.

A compliance matrix was produced, summarizing legal coverage for all 14 FLEXI-cross solutions across five regulatory domains, ensuring transparency and accountability. More details are described in Deliverable D4.6.

4.1.9 Standardization Activities

The FLEXI-cross project aimed to ensure that its modular border control solutions are not only compliant with current legal frameworks but also aligned with evolving European and international standards. This activity enhances interoperability, trust, and long-term uptake across EU border systems. More details are described in Deliverable D4.6.

4.1.9.1 Initial Research and Gap Identification

The process began with a comprehensive gap analysis, where existing standardization frameworks were reviewed to identify unmet needs in areas relevant to FLEXI-cross solutions—including biometrics, AI decision support, UAV surveillance, sensor fusion, and blockchain.

Key SDOs (Standard Development Organizations) identified included:

- ISO/IEC JTC1/SC42 (AI)
- IEEE P7000 series (AI ethics)
- ISO/IEC SC37 (Biometrics)
- ETSI ISG PDL (Blockchain)
- CEN/TC 278 (Transport data exchange)

The analysis revealed critical standardization gaps in:

- Mobile biometric verification across jurisdictions
- Privacy-aware AI explainability
- Secure integration of edge devices (UAVs, acoustic sensors)
- Role-based data sharing across agencies
- Blockchain identity and traceability protocols

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4.1.9.2 Strategy Design and Customization to FLEXI-cross

A solution-by-solution mapping was performed using the FLEXI-cross Catalogue. Each technical tool was aligned with existing standards—or flagged new contributions.

A table of standards is provided in D4.6.

Table 11 Policy contribution for FLEXI-cross solution

Solution ID	Solution Title	Legal Anchor	Policy Contribution
S1	Biometric Recognition – Face Recognition	GDPR, EES, Charter of Fundamental Rights	Provides AI-driven, standards-compliant facial verification to reduce fraud, enhance security, and ensure lawful biometric use.
S2	Biometric Recognition – Personal Data Extraction	GDPR, EES	Uses OCR and ID validation to automate document verification, improving throughput and ensuring accuracy within lawful constraints.
S3	FACE-VI Mobile App	GDPR, EU Digital Strategy	A portable biometric tool that enables compliant on-the-go ID verification with deep learning, aiding flexible, rights-based enforcement.
S4	Citizen App	GDPR, Charter	Facilitates two-way communication between travellers and border authorities; supports consent-based data exchange and user empowerment.
S5	Organization Risk Assessment	Customs Risk Strategy, Schengen Code	Helps allocate border control resources based on aggregated risk factors, compliant with transparency and oversight principles.
S6	Visual Analytics Dashboard	GDPR, EU Security Union Strategy	Provides actionable insights for authorities using lawful data aggregation, enhancing transparency and operational intelligence.
S7	Augmented Reality Situational Awareness	Charter, EU AI Act (draft)	Offers real-time, rights-sensitive visual feedback to border officers via AR interfaces, boosting efficiency and compliance.
S8	On Board Unit	ePrivacy Directive, GDPR	Enables lawful real-time vehicle tracking and verification, reducing inspection delays and improving cross-border traffic control.
S9	INUS-UPE – Intelligent UxV Surveillance Platform	EU AI Act (draft), Fundamental Rights	Combines UAVs and pattern recognition to monitor crowds, using legal safeguards for automated detection in public spaces.
S10	Context Risk Assessment Platform	GDPR, Schengen Code	Performs AI-assisted threat detection on vehicle and traveller data in real-time, with embedded alert and privacy filters.

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Solution ID	Solution Title	Legal Anchor	Policy Contribution
S11	Position Prediction	GDPR, Law Enforcement Directive	Predicts sound source origins to locate hidden threats while adhering to legal limitations on surveillance and acoustic data use.
S12	Cargo Content Identification	Customs Risk Strategy, Blockchain Regulation (forthcoming)	Uses blockchain to securely trace cargo origins, ensuring tamper-proof compliance with customs and sanitary regulations.
S13	Event Driven Situational Awareness (EDSA)	GDPR, Charter	Aggregates inputs from multiple systems (AR, drones, sensors) into one dashboard, enhancing emergency response within legal boundaries.
S14	Data Export for Border Authorities	GDPR, EES Data Models	Enables secure, role-based data export in formats compliant with EU privacy rules, simplifying lawful interoperability and analysis.

4.1.9.3 Engagement with Standardization Bodies

The next steps for engagement include:

- Assign consortium members to monitor specific SDO working groups:
  - Facial Recognition: ISO/IEC JTC1/SC37
  - AI Ethics: ISO/IEC SC42 + IEEE P7000 series
  - Cybersecurity: ECSO, ENISA, ETSI TC CYBER
  - Blockchain: ISO/TC 307 and ETSI PDL
- Establish liaison roles with CEN/TC 278 for ITS-related data exchange.
- Involve border policy stakeholders through DG HOME and eu-LISA working groups to ensure policy compatibility.

4.1.9.4 Adoption and Pilot-Based Implementation

Standard-aligned components were embedded into real-world pilot environments across port, road, and rail borders:

- The biometric app was tested in live pre-registration and identity checks (UC2)
- The dashboard was validated with Romanian border officers for decision support (UC1/UC3)
- UAV feeds and AR overlays were tested into coordinated surveillance workflows

4.1.9.5 Consolidated Impact and Future Outlook

FLEXI-cross has demonstrated how standardization can be integrated as both a development driver and a policy enabler. The project advanced EU objectives on:

- Interoperable border security
- Rights-based AI adoption
- Cross-border data governance

BEIA's ongoing role in Technical Committee 6 at ASRO (Romanian Standards Association) will support the national dissemination of these efforts and foster proposals for new or updated standards in mobile surveillance, IoT-based identity verification, and secure citizen engagement.

4.2 Training programs/events and materials

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In addition to strategic capacity building, FLEXI-cross delivered hands-on training through field demonstrations, rehearsals, and immersive user interactions. These training activities were critical for bridging the gap between technology readiness and user readiness.

Although the organised webinars were primarily internal, they laid important groundwork for subsequent open demonstration sessions and cross-project knowledge exchange. These activities were planned to involve observers and invited experts from other EU initiatives, enabling:
Independent validation of the FLEXI-cross approach in operational scenarios.
Identification of opportunities to integrate complementary technologies and methodologies.
Promotion of project results to maximize synergies, uptake, and long-term sustainability of solutions developed under Horizon Europe.

4.2.1 Planning, preparation, and administration of the training sessions, including engagement with internal stakeholders

The training webinars were carefully planned and executed through a structured, multi-phase process designed to ensure clarity, inclusiveness, and operational relevance for all participants: Technical teams collaborated closely to develop comprehensive demonstration scenarios for each of the three use cases—UC1 (port surveillance), UC2 (road border checks), and UC3 (rail inspections). This preparation included:

- Drafting detailed scripts and step-by-step workflows to illustrate how the systems would operate in real conditions.
- Pre-recording selected data streams and simulated sensor feeds in cases where live demonstrations were impractical due to infrastructure constraints or data protection considerations.
- Preparing supporting materials such as user guides, scenario presentations, and technical documentation tailored to different audiences (technical staff, operational personnel, and policy stakeholders).
- Conducting internal dry runs to test webinar platforms, content sequencing, and interactive elements, ensuring smooth delivery during the live sessions.

4.2.2 Administration and Operational Coordination

To ensure meaningful and sustained stakeholder engagement, FLEXI-cross adopted a systematic, user-centric administrative approach to planning and conducting all workshops, pilot sessions, demonstrations, and internal validation activities. This process was designed not only to facilitate smooth logistics but to build a shared understanding of the project's goals, tools, and technical requirements among a diverse group of end-users, operators, and institutional stakeholders.

From the earliest phases of engagement, the project placed emphasis on clear, targeted communication. Prior to each session, technical, strategic, or operational participants received briefing materials outlining the objectives, expected contributions, and key discussion points.

To further support this preparatory effort, FLEXI-cross produced a set of handbooks, complete with tutorials for each of the tools developed. These documents include both technical setup instructions and contextual guidance on how the tools integrate into existing border procedures.

Logistically, the project team took a proactive approach to time management and accessibility. Sessions were scheduled with sensitivity to the geographical distribution and time zones of participants, with flexible slots (Doodle) to accommodate both field-level personnel and policy-level

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stakeholders. For key discussions, recordings and follow-up summaries were made available to ensure continuity for those who could not attend live.

Where feasible, technical liaisons or site-specific focal points were appointed to serve as intermediaries between the project team and operational units. These liaisons played an important role in answering pre-session questions, gathering feedback, and troubleshooting connectivity or access issues ahead of time.

By anticipating stakeholder needs, providing accessible preparatory content, and supporting interaction across diverse institutional layers, the project created the conditions necessary for genuine collaboration. This structured approach ensured that every engagement, whether for demonstration, training, or co-design—was both efficient and impactful, accelerating learning curves and reinforcing stakeholder ownership of the deployed solutions.

4.2.3 Engagement

To ensure meaningful engagement and user-centered design throughout the FLEXI-cross project, each demonstration, webinar, and validation session was structured to promote active participation and immediate, qualitative feedback.

Each engagement began with a brief contextual overview, followed by hands-on or visual demonstrations of specific components—such as biometric verification, sensor integration, mobile deployment, or dashboard analytics. Immediately following each demonstration, dedicated Q&A segments were held to allow participants to ask questions and probe technical or operational aspects in greater detail. These exchanges often surfaced real-time concerns or suggestions, such as limitations in connectivity, ergonomic preferences for mobile devices, or the need for language localization—valuable insights that fed directly into iterative refinements of the system.

Importantly, each session included structured discussion segments where participants were invited to reflect openly on key aspects such as usability, interface clarity, response times, and perceived readiness for field deployment. These discussions, though informal, yielded useful insights.

This feedback methodology—anchored in dialogue, reflection, and hands-on experience—enabled the FLEXI-cross consortium to gather actionable insights.

Overall, the interactive and participatory nature of the sessions provided a rich, real-time understanding of stakeholder expectations, operational realities, and system acceptance.

Through this structured approach to planning, delivery, and follow-up, the project ensured the training webinars were not only informative but also instrumental in building shared ownership, aligning expectations, and preparing all participants for the upcoming pilot deployments under real-world operational conditions. Table 11 below shows the trainings and the field trials conducted during the project.

Table 12: Training demonstrations and Field trials

Event	Description & Focus	Location / Date	Outcomes
UC1 Live Demo: Galați Port	Showcased AI-based pattern detection, acoustic sensors, and object tracking. Users practiced live threat monitoring and response.	Romania / Nov 2024	Increased confidence in AI for risk detection. Validation of multimodal tools.
UC2 Live Demo:	Demonstrated mobile biometric checks, AI-based vehicle behaviour analytics, and legacy system	Greece-Bulgaria / Feb 2025	Showed how digital tools reduce border delays and improve security throughput.

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Event	Description & Focus	Location / Date	Outcomes
Ormenio Road Border	integration. Included mobile app for pre-registration.		
UC3 Live Demo: Romania-Moldova Rail Border	Trained users on biometric recognition, radiation sensors, and human trafficking detection. Tested compatibility with existing infrastructure.	Romania / Nov 2024	Confirmed reliability in detecting threats in dynamic rail environments. Enhanced readiness for portable systems.
Visual Analytics Dashboard Rehearsal	Border staff interacted with the real-time event dashboard, using drill-down features, live tracking, and anomaly mapping to assess security incidents.	Romania / Apr 2025	Validated UI/UX design. Ensured operational relevance and ease of use for frontline staff.
UC1 Webinar – Internal Training Webinar	Strengthening Border Intelligence: FLEXI-cross UC1 Webinar Explores Port Surveillance Capabilities and Collaboration Potential	Online / March 2025	Participants gained insights into the system's structure and user interactions. The webinar emphasized inter-agency coordination, data exchange between modules, and configurable thresholds. This increased trust among future users while validating alignment with current port operation needs. The session also introduced supporting materials like scenario slides and training booklets.
UC2 Webinar – Internal System Rehearsal	FLEXI-cross's UC2 use case focuses on enhancing road border procedures at the Greek-Albanian border. The internal training session gave participants a hands-on preview of the platform's biometric, vehicle inspection, and user interface components—setting the stage for full-scale rehearsals.	Online / March 2025	The training revealed strong user engagement, detailed feedback on scenario realism, and raised UI/UX improvements that will guide the final interface refinements. Most importantly, the exposure built confidence in system maturity for the coming live test. Input from stakeholders about relocating some scenario components and refining AI/GDPR documentation was directly recorded for implementation.
UC3 Webinar – Technical & AI Training	FLEXI-cross's UC3 scenario, focused on rail-based border control between Romania and Moldova, was the focus of a technical training webinar. The session reviewed advanced modules for biometric, cargo, and	Online / March 2025	The training gave operational staff and developers a common understanding of what constitutes actionable alerts. The review of real datasets and scenarios demonstrated both the

Event	Description & Focus	Location / Date	Outcomes
	behaviour monitoring powered by AI—ensuring readiness for upcoming rail trials.		maturity of the modules and their usability in low-infrastructure rail environments.

4.2.4 Training Content and Methodology

- Immersive Learning Through Field Trials

Each demo doubled as a training opportunity, where operators were coached in real time while executing tasks like identity checks, cargo inspection, and anomaly resolution. They navigated full workflows from detection to decision making using the FLEXI-cross toolkit.

Figure 44: Field trials

- Interactive Materials and Onboarding Support

Training materials included detailed presentations of the developed tools, handbooks and step-by-step tutorials. These materials helped overcome the learning curve for technologies such as AI-based decision support, tethered UAVs, and blockchain-based verification.

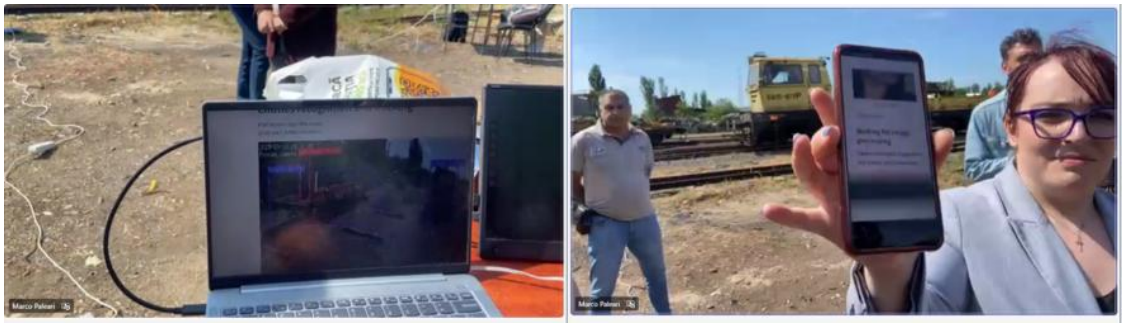

Figure 45: onboarding materials

- Public-Private Training Collaboration

Demonstrations featured joint sessions between public border authorities and private technology developers, encouraging knowledge exchange, co-learning, and relationship-building.

- Preparation for Final Showcasing Events

These demonstrations and rehearsals served not only to validate tools, but also to prepare users for the final deployment, where complete system integration and cross-border functionality would be assessed.

- Internal training activities

As the FLEXI-cross project progressed toward field deployment, its internal training activities emerged as drivers of both system maturity and user preparedness. Between late 2024 and early 2025, the project conducted a series of structured internal webinars and live demonstrations tailored to its three key operational scenarios—port (UC1), road (UC2), and rail (UC3). These sessions were not only technical rehearsals but also learning opportunities that strengthened coordination among developers, border authorities, and institutional stakeholders.

Each webinar served as a focused exploration into the project's modular toolkits, allowing participants to visualize workflows from end to end—whether identifying a threat in a noisy port terminal, scanning a suspicious vehicle at a road checkpoint, or verifying passenger behavior on a rail line. Each session was designed to capture real-time input through live Q&A, scenario walkthroughs, and targeted discussions on usability, clarity, and AI behavior.

- The UC1 webinar, centered on the Galați Port use case, introduced border and customs authorities to acoustic monitoring, unusual pattern extraction, etc modules. These capabilities were demonstrated using simulated port scenarios, enabling participants to follow detection-to-response workflows and discuss thresholds, alert priorities, and collaborative decision-making. The session reinforced the system's relevance to maritime surveillance while building trust in its AI-based risk evaluation logic. Supporting materials—including scenario slides and system booklets—helped new users onboard quickly and efficiently.

- For UC2, the training focused on road border operations at the Greek Bulgarian border. Participants interacted with mobile biometric verification tools, vehicle inspection kits, and a pre-registration app. The session prompted robust feedback on the user interface, data flow visibility, and the practicality of integrating these tools with legacy systems already in use at national borders. Several suggestions—such as interface refinements, clearer GDPR notifications, and alternate placement of inspection tools—were noted and incorporated into upcoming revisions. This rehearsal gave participants confidence in the platform's readiness while also ensuring their operational realities were reflected in the final system design.

- The UC3 webinar addressed the challenges of rail-based inspections at the Romania-Moldova border, focusing on biometric scanning, cargo monitoring, and behavioral analytics. Given the infrastructure constraints of railway checkpoints, this session emphasized the reliability of the tools in lower-connectivity environments. Participants gained hands-on exposure to the system's AI modules for facial recognition, radiation detection, and object tracking. Discussions emphasized how alerts were generated and validated, with participants offering insights on false-positive handling, data prioritization, and inspection timing—crucial for real-time decision-making in fast-moving rail environments.

In addition to the thematic webinars, a separate rehearsal was held for the project's visual analytics dashboard. Border staff interacted directly with live tracking features, anomaly mapping tools, and drill-down functionalities. This session validated the user interface's intuitiveness, confirming that non-technical users could operate the platform confidently in the field.

Throughout all sessions, the FLEXI-cross team supported training with detailed presentations, embedded guides, simplified interfaces, handbooks and step-by-step tutorials.

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5 Conclusions

This final version of the Dissemination, Communication, Capacity Building and Training Activities series of deliverables provided the final and comprehensive overview of all the efforts and activities undertaken by all the project partners during the whole project lifecycle which aimed mainly to raise awareness, improve engagement, and make sure all the knowledge and experience are shared among stakeholders and shared externally with subject matter expert.

As clearly demonstrated within this document significant progress was achieved across all targeted domains:

1. Dissemination activities that have progressed in parallel with the technical work done by all the project partners, highlighting the main innovations, outcomes, and project contributions through scientific publications, project newsletters, media presence, and participation in events.
2. Communication efforts that focused on increasing the visibility and outreach of the project, both within the research community and among broader audiences. These included the consistent use of social media, press releases, project website updates, and strategic campaigns aligned with key milestones.
3. Capacity building and training activities played a crucial role in empowering internal and external stakeholders by providing technical insights and enabling the uptake of the project results. Dedicated workshops, tutorials, and materials were delivered and aligned with the evolving needs of partners and end users.

Importantly, this deliverable also reflects how each activity performed against the predefined KPIs, confirming that the project has met its expected impact in terms of visibility, knowledge dissemination, and stakeholder engagement. Where certain activities were initially dependent on the availability of validated results, they have since been activated and successfully completed in the final stages of the project.

As the FLEXI-cross project concludes, the communication, dissemination, and capacity-building actions have collectively contributed to reinforcing the project's value, ensuring the sustainability of its results, and laying the groundwork for potential exploitation and future collaboration.

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